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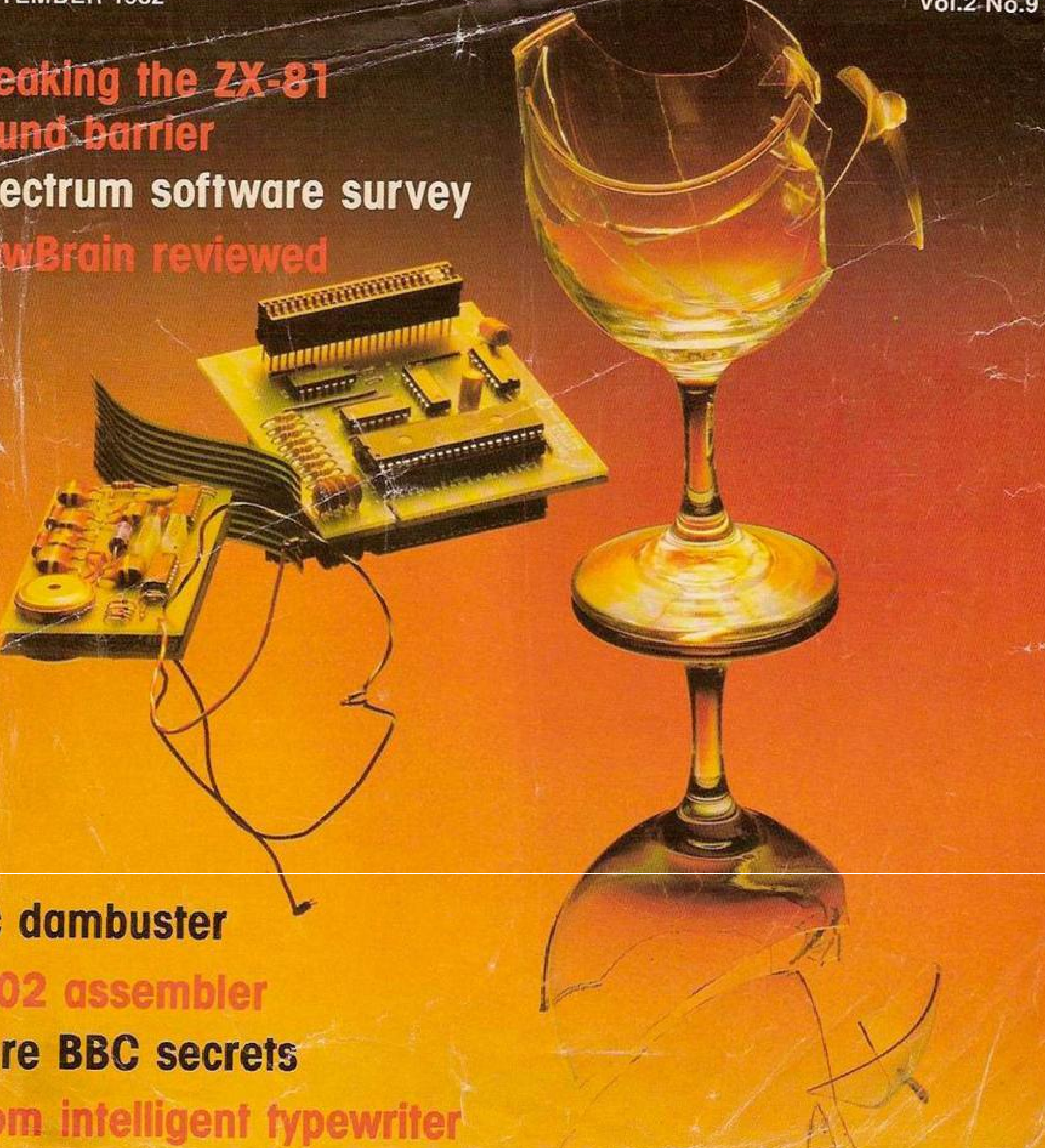
SEPTEMBER 1982

Vol.2 No.9

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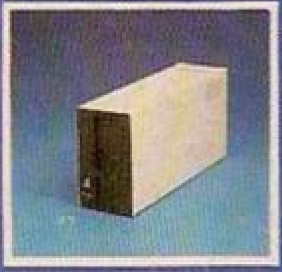
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EDITORIAL

MANUFACTURERS HAVE PUSHED the prices of micros offering colour and sound into a steep nosedive; no-one will be too bothered if they never pull out of it. But to be able to drop so far so quickly the machines at the lowest end of the price range have had to jettison all unnecessary weight. In the name of price-streamlining, full sound facilities are often nudged through the escape-hatch at an early stage.

As a result we have the Spectrum, which seems to have been designed to satisfy popular demand for inaudible noise, and the Dragon 32's endearing croak. This kind of facility makes the whole theme of sound appear limited. Yet until now low-cost computing has neglected everything from music, through synthetic speech to voice recognition.

Sound will be at the very heart of the way micros operate and are operated in the near future, and games-playing may well be the force which will put it in that position. After all, joysticks and track-balls had languished in computer laboratories until the advent of consumer computer games.

The prospect of large sales of games using, say, speech recognition — the most problematical area in sound — could make manufacturers put more money into its development. Then those who enjoy battle games could easily find themselves in command of a squadron of aircraft on the screen, giving verbal "bandits at two o'clock"-type warnings to fellow pilots while fending off attacks using joystick control.

If that sounds too futuristic, there are instances much closer to the present where sound could be used and for which relatively inexpensive hardware already exists. As usual, software development lags behind. Take, for example, computer speech. You can buy specialised chips which hold all the phonemes in English but hours must be spent programming the device to speak even the simplest phrases with the correct pronunciation and inflection. Music must be the most obviously neglected area — the chips exist and a small piano-format keyboard could be offered with most micros for little extra cost. It would be easier to connect than a joystick.

Tomorrow's computer buffs will be mystified that manufacturers only turned to sound when they wanted a new feature to tempt the buyer. As they chat with their machines they will wonder how we ever managed without it. ■

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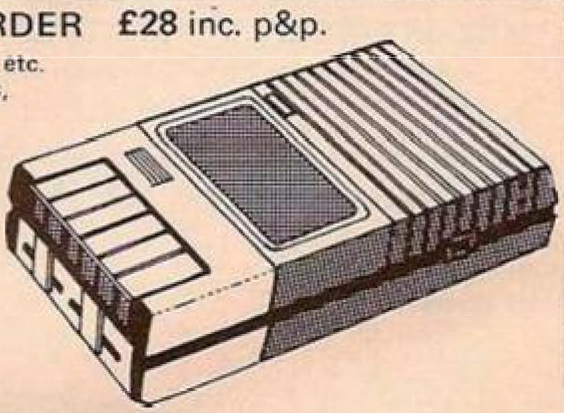
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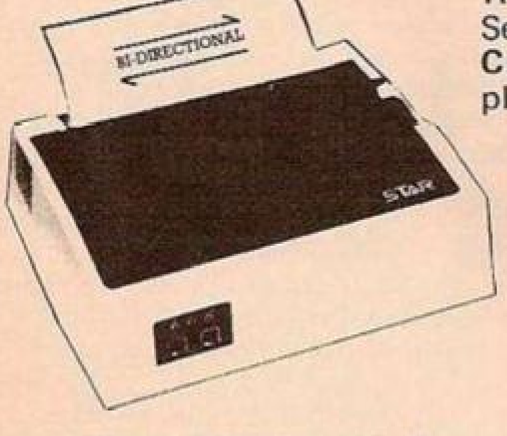
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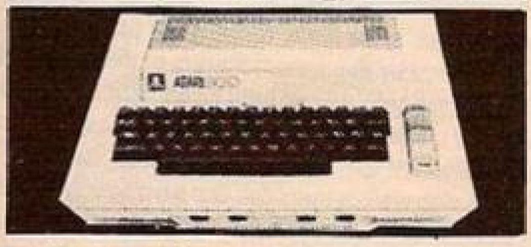


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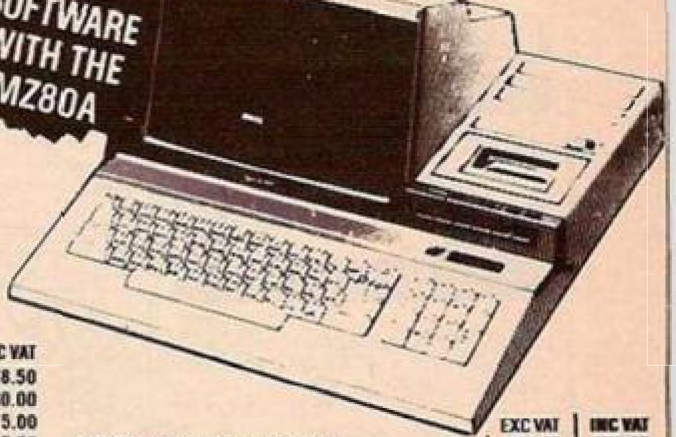
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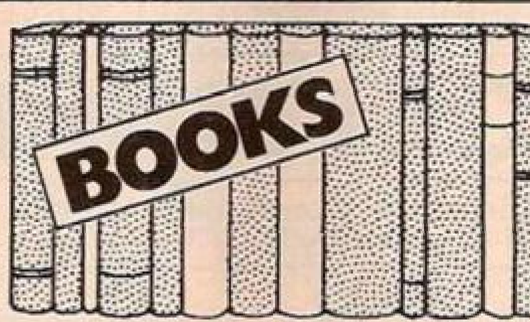
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New ZX81 Software from Sinclair.



A whole new range of software for the Sinclair ZX81 Personal Computer is now available – direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education, and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX 16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

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Games

Cassette G1: Super Programs 1 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.
Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.
Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.
Description – Fives games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Petrol.
Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.
Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.
Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)
Hardware required – ZX81.
Price: – £4.95.
Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.
Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Star Trail (plus blank tape on side 2).
Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – What are Biorhythms? Your Biohythms.
Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Programs – Backgammon. Dice.
Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Chess, Chess Clock.
Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.

Cassette G12: Fantasy Games (Psion)
Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.
Price – £4.75.
Programs – Perilous Swamp. Sorcerer's Island.
Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

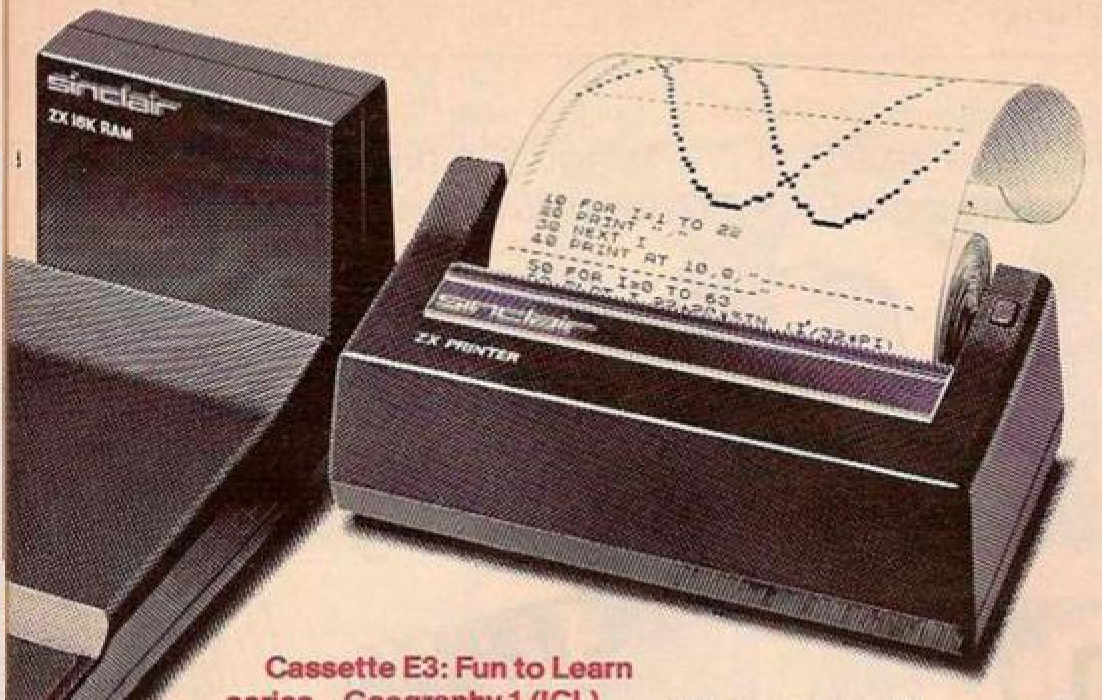
Cassette G13: Space Raiders and Bomber (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £3.95.
Programs – Space Raiders. Bomber.
Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Program – Flight Simulation (plus blank tape on side 2).
Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Novelists. Authors.
Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Poets, Playwrights. Modern Authors.
Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?



Cassette E3: Fun to Learn series – Geography 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Towns in England and Wales. Countries and Capitals of Europe.
Description – The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series – History 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Events in British History. British Monarchs.
Description – From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series – Mathematics 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Addition/Subtraction. Multiplication/Division.
Description – Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series – Music 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Composers. Musicians.
Description – Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series – Inventions 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Inventions before 1850. Inventions since 1850.
Description – Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series – Spelling 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Series A1-A15. Series B1-B15.
Description – Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

Business/household

Cassette B1: The Collector's Pack (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Collector's Pack, plus blank tape or side 2 for program/data storage.
Description – This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Club Record Controller plus blank tape on side 2 for program/data storage.
Description – Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information – eg type of membership.

Cassette B3: VU-CALC (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Program – VU-CALC.
Description – Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Psion)
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Price – £7.95.
Programs – VU-FILE. Examples.
Description – A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

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	G11: Chess	40	£6.95	
	G12: Fantasy Games	41	£4.75	
	G13: Space Raiders & Bomber	42	£3.95	
	G14: Flight Simulation	43	£5.95	
	E1: English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
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	E3: Geography 1	46	£6.95	
	E4: History 1	47	£6.95	
	E5: Mathematics 1	48	£6.95	
	E6: Music 1	49	£6.95	
	E7: Inventions 1	50	£6.95	
	E8: Spelling 1	51	£6.95	
	B1: Collector's Pack	52	£9.95	
	B2: Club Record Controller	53	£9.95	
	B3: VU-CALC	54	£7.95	
	B4: VU-FILE	55	£7.95	
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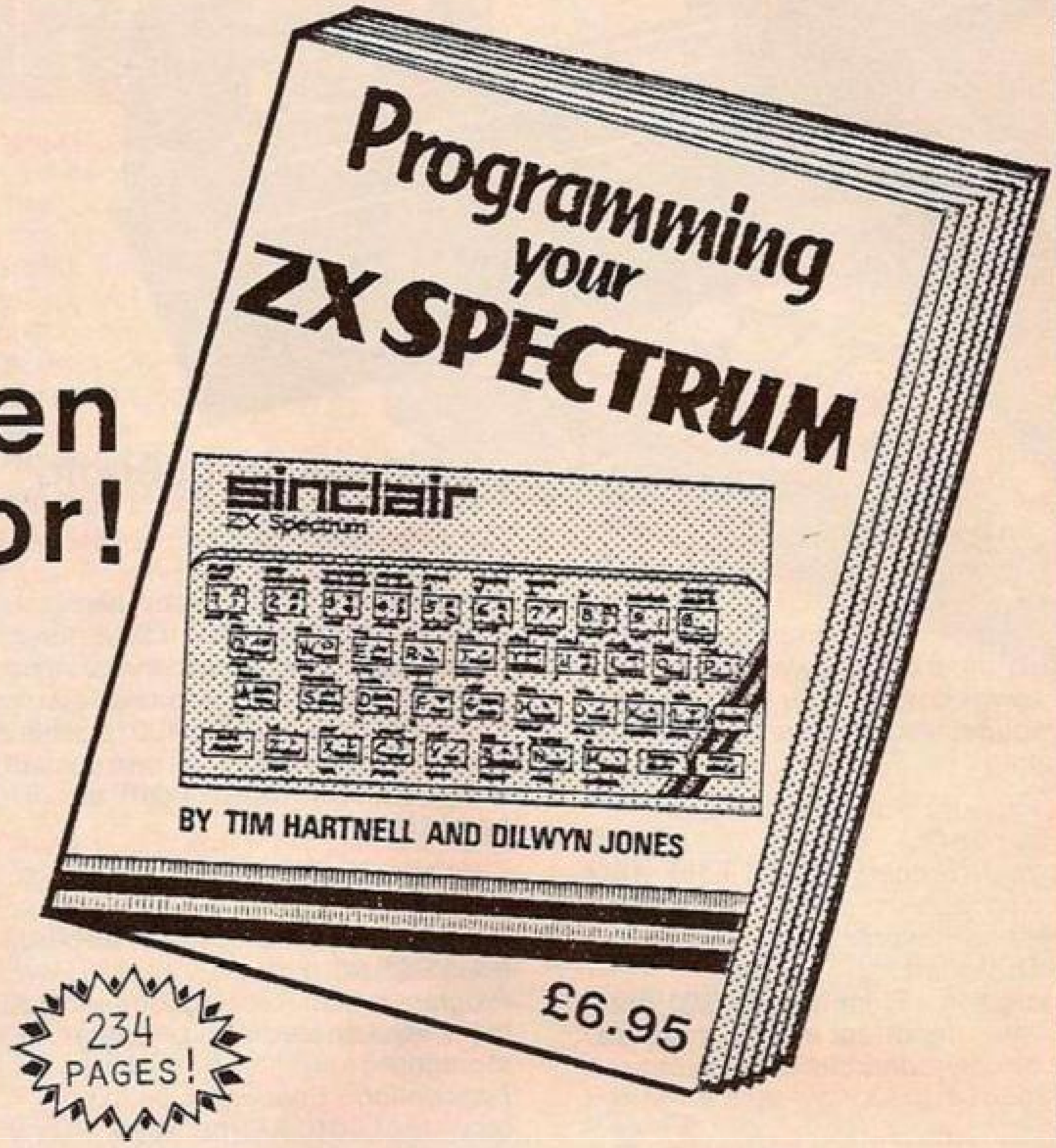
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This is a book that will allow you to make the most of the ZX Spectrum — a book that will lead to you 'expert programmer' status within weeks.

There are two major sections — the first for those who have no previous experience of computer programming, and the second containing advanced material for really powerful programming. All sections of the book make good use of the full eight colours, sound generation and high-resolution graphics. You're also shown how to make the most of Sinclair BASIC features such as DEF FN, SCREEN$, MERGE and FLASH.

Key features of 'Programming Your ZX Spectrum'

- Using the colour effectively — BRIGHT, FLASH, INVERSE and more.
- Sound — there's more to the BEEP than meets the ear.
- Finding your way around the keyboard, the use of *every* keyword, command and function.
- High resolution graphics — how to use them for stunning displays, how to create your own version of the famous arcade game 'Pacman' with user-defined graphics.
- The ZX Spectrum has the full ASC11 character set and this book includes a word processor program to make best use of it.
- The Spectrum LOAD and SAVE is highly reliable, and the MERGE and VERIFY features increase its flexibility. Programming Your ZX Spectrum outlines simple ways to ensure you never lose a program.

The ZX Printer

All program listings are dumped direct from the ZX Spectrum, so all programs are guaranteed to run.

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An appendix to this book details the commands needed to use your ZX Spectrum with the Microdrive microfloppy so you'll be ready when it comes on the market.

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DYNACOMP
Alpha Fighter
Chompelo
Crystals
Forest Fire
Intruder Alert
Monarch
Moonprobe
Moving Maze
Nominoes Jigsaw
Rings of The Emp
Space Tilt
Space Trap
Stud Poker
Triple Blockade

EDUCATION from APX
Algicalc
Atlas of Canada
Cubbyholes
Elementary Biology
Frogmaster
Hickory Dickory
Inst Comptg Dem
Lemonade
Letterman
Mapware
Maths-Tac-Toe
Metric & Prob Solvg
Mugwump
Music Terms/Notatn
Musical Computer
My First Alphabet
Number Blast
Polycalc
Presidents Of U.S.
Quiz Master
Starware
Stereo 3D Graphics
Three R Math Sys
Video Math Flash
Wordmaker

EDUCATION from ATARI
Conv French
Conv German
Conv Italian
Conv Spanish
Energy Czar
European C & Caps
Hangman
Invit To Prog 1/2/3
Kingdom
Music Composer
Scram
States & Capitals
Touch Typing

EMI SOFTWARE
British Heritage
Cribbage/Dominoes
Darts
European Scene Jig
Hickory Dickory
Humpty Dumpty
Jumbo Jet Lander
Snooker & Billiards
Submarine Commdr
Super Cubes & Tilt
Tournament Pool

ENTERTAINMENT from APX
Alien Egg
Anthill
Attank
Avalanche
Babel
Blackjack Casino
Block Buster
Block 'Em
Bumper Pool
Castle
Centurion
Checker King
Chinese Puzzle
Codecracker
Comedy Diskette
Dice Poker
Dog Daze
Domination
Downhill
Eastern Front
Galahad & Holy Grl
Graphics/Sound
Jax-O
Jukebox
Lookahead
Memory Match
Midas Touch
Minotaur
Outlaw/Howitzer
Preschool Games
Pro Bowling
Pushover
Rabbotz
Reversi II
Salmon Run
747 Landing Simul
Seven Card Stud
Sleazy Adventure
Solitaire
Space Chase
Space Trek
Sultans Palace
Tact Trek
Terry
Wizards Gold
Wizards Revenge

ENTERTAINMENT from ATARI
Asteroids
Basketball
Blackjack
Centipede
Chess
Entertainment Kit
Missile Command
Pac Man
Space Invaders
Star Raiders
Super Breakout
Video Easel

ON LINE SYSTEMS
Crossfire
Frogger
Jawbreaker
Mission Asteroid
Mouskattack
Threshold
Ulysses/Golden Fl
Wizard & Princess

PERIPHERALS
Centronics Printers
Disk Drive
Epsom Printers
Program Recorder
RS232 Interface
Thermal Printer
16K Memory RAM
32K Memory RAM

PERSONAL INT from APX
Adv Music System
Banner Generator
Blackjack Tutor
Going To The Dogs
Keyboard Organ
Morse Code Tutor
Personal Fitness Prg
Player Piano
Sketchpad

PROGRAMMING AIDS from Atari
Assembler Editor
Dsembler (APX)
Microsoft Basic
Pascal (APX)
Pilot (Consumer)
Pilot (Educator)
Programming Kit

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FREE LITERATURE

I am interested in purchasing an Atari 400/800 computer and would like to receive copies of your brochures and test reports as well as your price list covering all of the available Hardware and Software:

Name ....

Address ....

....

....

Postcode ....

YC 0982 — Your Computer — September 1982

Probably the fastest microcomputer in the universe

the JUPITER ACE only £89.95.



All inclusive Price

For £89.95 you receive your Jupiter Ace, a mains adaptor, all the leads needed to connect to most cassette recorders and T.V.s (colour or black and white), a software catalogue and a manual.

The manual is a complete introduction to the world of personal computing and a course in FORTH programming on the Ace.

Even if you are a complete newcomer to computers, the manual will guide you step by step from first principles to confident programming.

The price includes postage packing and V.A.T.

Key Features

- Revolutionary microcomputer language FORTH.
- Full-size moving-key keyboard.
- User-defined high-resolution graphics.
- Programmable sound generator.
- Floating point arithmetic.
- Fast cassette interface.
- Upper and lower case ascii character set.
- 24 x 32 character flicker-free display.

The Jupiter Ace uses FORTH

The Ace is set apart from all other personal computers on the market by its use of a revolutionary language called 'FORTH'. Some computer languages are easy for humans to understand, others are easy for computers; FORTH is most unusual in being both. Its underlying principles are so simple that it takes even a newcomer to computers only a few minutes to learn how to do calculations on the Ace, yet the very same principles are powerful enough to allow you to invent your own extensions to the language itself.

At the same time, the memory-saving coded form used to store your programs inside the Ace allows it to obey them very fast — typically in less than a tenth of the time it would take to do the same thing using a different language. Amongst other things, this makes the Ace ideal for games.

FORTH's unique combination of speed, versatility and ease of programming has already made it a prime choice for professional applications as diverse as pub games and radio telescopes, and gained it an enthusiastic national user group. Now the Jupiter Ace can bring this addictive language into your own home.

Designed by Jupiter Cantab

Leading computer Designers Richard Altwasser and Steven Vickers have a reputation for pushing technology forwards. After playing the major role in creating the ZX Spectrum they formed Jupiter Cantab to develop their latest brainchild the Jupiter Ace.

Technical Specification

Hardware

Processor/Memory
Z80A running at 3.25 MHz. 8K bytes ROM 3K bytes RAM.

Input
40 moving-key keyboard with auto-repeat on every key.

Output
Memory-mapped 32 x 24 character display with high resolution user graphics. Output to drive normal UHF TV set on channel 36.

Sound
Provided by internal. loudspeaker.

Cassette
Load Save & Verify at 1500 baud, separate data storage.

Software, FORTH

Data Structures
Integer, Floating point and String data may be held as constants, variables or arrays with multiple dimensions and mixed data types.

Control Stuctures
IF-THEN-ELSE, DO-LOOP, BEGIN-WHILE-REPEAT, BEGIN-UNTIL, all may be mixed and nested to any depth.

Operators
Mathematical +, —, X, ÷.
Logical AND, OR, NOT, XOR.
Comparison <, >, =.

Program Editing
FORTH words may be listed, edited and redefined. Comments are preserved when words are compiled.

Order Form

The **Jupiter Ace** is available only by mail order. Please allow up to 28 days for delivery.

Send cheque or postal order with the form to:—

JUPITER CANTAB, 22 FOXHOLLOW, BAR HILL, CAMBRIDGE CB3 8EP

Please send me:—

☐ JUPITER ACE MICROCOMPUTER(S) @ £89.95.

Name. Mr/Mrs/Miss ____________________

Address ____________________

____________________ F

YOUR LETTERS

SEA BATTLE

My program Sea Battle in the July issue contained a few mistakes. The amended lines should read as:

```
120 PRINT TAB(C-1,20)"<=>"
140 IF Z$="Z" THEN D=1
150 IF Z$="X" THEN D=2
154 IF C>37 THEN C=37
190 PRINT TAB(0,23)"BASES
    LEFT=";F
212 IF B=20 THEN PRINT TAB
    (A,B)" "
422 IF C$="Y" THEN GOTO 23
430 CLS:PRINT"MORE THAN 10
    PLANES HAVE LANDED":
    GOTO 410
```

Line 200 should be deleted. There should not be any space between Tab and the bracket as shown in the program.

Lakith Leelasena,
Ilford,
Essex.

ZX DEFECTS

Now that I have had my ZX Spectrum for two weeks I feel that I should point out some of its deficiencies.

First, to only be able to have line numbers in the range 0 to 9999 is a serious limitation on a 48K computer. Following the normal convention of line numbering in tens, this only allows 1,000 lines of code and, even using some multi-statement lines, this is not enough.

Secondly, to have to pull out the ear-phone plug each time a program is saved strikes me as a design fault. Thirdly, the keyboard layout would be improved by placing both the shift keys together at the bottom left of the keyboard. Also you can never be sure that the key you have hit has registered with the micro, and the red printing on the grey keys is well-nigh illegible.

M R Farley,
Maidenhead,
Berkshire.

COMPUTER FAIR

In April I went to the Computer Fair,
A charming young lady accosted me there.
"A message from Uncle Clive," she said
And gave me a leaflet before she fled.
"The Spectrum — what's that?" I thought with a smile,
"Another leaflet to add to my pile."
I read it more fully going home on the train,
And shouted "My God! he's done it again."
So I ordered a Spectrum by 'phone on the Sunday,
"Perhaps it will come less than four weeks from Monday."
The next week I sold my ZX-81
And sat back and waited for a Spectrum to come.
I waited and waited for several weeks more,
And then a white card dropped through the door.
"Your order is being processed for despatch."
On May 26 — I suspected no catch.
A 'phone call or two — and when I get through —
"There's a further delay — and we're sorry too."
Your Computer — July — on page 17,
I read about Spectrum — but what does it mean!
"Sinclair Research say the backlog is cleared."
If that's so why hasn't my Spectrum appeared?
I must be a "backlog" — I ordered so early,
It's such a long time since I met Sinclair's girlie.
Oh what can I do now? — If I write in verse
They won't want another so the delay can't get worse.
I'll chance it — my recorder's all dusty,
And what's more I think my Basic's gone rusty!

D J Shannon,
Bognor Regis,
Sussex.

ALIEN ATTACK

While there was no actual mistake in the hex listing for my program Alien Attack which appeared in the July edition of Software File, two bytes are unclear and I know that some people have had trouble as a result.

Location 16886 should read 9B, not 98. This affects the movement of the bullets — they turn into inverse division signs and stay off the bottom of the screen if this location is incorrect.

Location 16937 should read B4, not E4. This affects the working of the high score. Also, in listing 3, line 12 should read

```
IF A$="" THEN INPUT A$
```

Jon Jones,
Penylan,
Cardiff.

MACHINE CODE

I am pleased to see that a few more people have taken the plunge and are programming their ZX-81s in machine language — *Your Computer* July 1982. I believe their efforts have been well rewarded with better quality programs.

However, I believe that, as well as increasing the speed of the program, machine language should also occupy the smallest amount of memory possible and, in this context, I think that the program by D Clancy — page 91 of the July issue — could well be improved.

The following one-line program produces exactly the same screen border and only takes 28 bytes. It is

```
1 REM Y■E£ RND LN■ RND■=
)3□77?;?( RAND 7■47?(
        UNPLOT TAN
POKE 16529,119  }
POKE 16531,119  } direct commands.
POKE 16538,119  }
RAND USR 16514  }
```

also entered directly from the keyboard with no need for a hex loader.

The keywords are underlined and Rand/Unplot are entered by typing Then Rand/Then Unplot and rubout the word Then. Perhaps you would like to convert the statement back to machine-language mnemonics to see how it works.

S A Nicholls,
Keynsham,
Bristol.

FAST POKES

At long last my Spectrum has arrived, only 11 weeks after my order. Perhaps other lucky Spectrum owners would like to try the following Pokes, which are all concerned with the keyboard.

Poke 23561,5 — five × 1/50 second — shortens the delay before a key starts to repeat, Poke 23561,255 virtually turns off the repeat; and Poke 23562,1 makes the keys repeat much faster.

In the main Spectrum manual on page 138, it suggests Poking 255 into 23609 to make the keyboard beep, but I find this slows down the repeat too much. Instead, Poke 23609,50 which I feel gives the best compromise between speed and sound.

Stephen J Betts,
Eaton Bray,
Bedfordshire.

CLARIFICATION

With all due respect to Tim Hartnell, his reply to Martin Kuhn in the July's Response Frame is inaccurate: there is no need to put Save "Program Name" in the first line of the program. In fact there are at least two reasons for not putting it there.

First, you may wish to have one or more Rems containing machine code there. Secondly, if the program ends and you Run, the program will first try to Save.

The line, Save "Program Name" can be put anywhere provided the program jumps over it — for example, with a Goto during execution, but the simplest system is to put it at the end:

```
9997 STOP (not always needed)
9998 SAVE "PROGRAM NAME"
9999 RUN
```

Also, Line 9999 can be Goto (line number) or List or List (Line number). The Goto is necessary if you have saved unlisted variables which will be lost if you Run.

List is sometimes necessary if you wish certain Rems to be read before running. You may need to Poke a particular value before running or to read other instructions. The automatic List prevents you from absent-mindedly running immediately after loading and is really a more useful facility than the automatic Run. Page 110 of the manual covers this method without the List possibility.

Les Simpson,
Hornchurch,
Essex.

STRONG LINE

Congratulations on your strong line July editorial calling on the computer industry to give mail-order consumers a fair deal.

The new Supply of Goods and Services Bill will help micro-computer enthusiasts for it is certain to become law by the end of this Parliamentary session. It makes consumer rights statutory

That still leaves the problem of the mail-order company that goes to the wall taking its customers' money with it into liquidation.

We are campaigning strongly for the Customers' Prepayment (Protection) Bill, which recently failed in the Commons, to be reintroduced next session. Any support from readers would be most welcome.

Janet Upward,
Secretary, National Federation of Consumer Groups,
18 Queen Anne's Gate,
London SW1 9AA.

VIDEO MEMORY

The eventual introduction of the Sinclair ZX Microdrive for the Spectrum computer will surely spell the end for expensive disc drives. However, I believe the future of mass-memory storage for computers will be on conventional video recorders. These have many of the advantages of magnetic disc drives, as well as high-volume sales hence low production costs.

What the market needs is a video recorder which provides for multi-track audio recording for hi-fi buffs, an on-line data bus for computers and a teletext decoder in addition to video recording.

The recorder could store teletext pages on the tape. The freeze-frame facility of a video recorder could provide for on-line storage or retrieval of information for computers in a similar way to how disc drives work. So virtual memory for computers would not only be massive but cheap.

R Marsden,
Wakefield,
West Yorkshire. ■

Kenneth Kendall and Acorn take on the Daleks from America

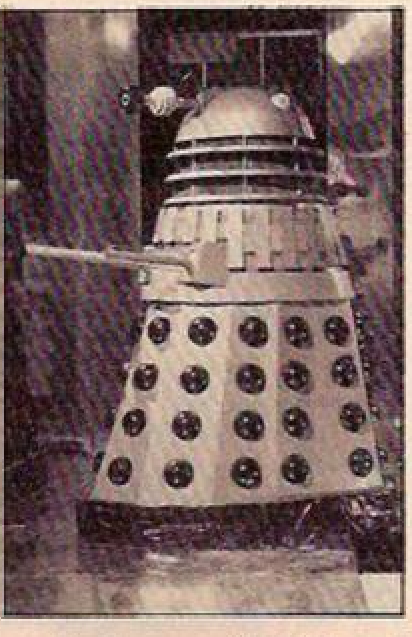
NEXT TIME you hear a computer talk it could sound more like a BBC newsreader than the American Dalek noises we are accustomed to hearing.



Most currently available speech chips were developed several years ago for the American market. Now Acorn has applied the latest technology to ex-newsreader Kenneth Kendall's voice and produced a BBC Micro that speaks BBC English.

According to one of Acorn's engineers this has two advantages: "First of all it is British English and secondly the quality is much better." Acorn will make the speech processor and a ROM containing useful words and numbers available in October for less than £30.

Later in the year they will produce a second ROM which will allow the BBC Micro to generate flowing phonetic speech which will sound remarkably like Kenneth Kendall.



Pac-Men snap at Vicmen

ATARI'S LAWYERS are snapping at the heels of Bug-Byte's Vicmen. Now Vicmen, which is similar to Atari's Pac-Man, has been withdrawn from sale for fear of costly legal proceedings.

Atari knows the profits games like Space Invaders or Pac-Man can generate and are keen to prevent others profiting from their ideas. As more people learn to use computers it becomes more difficult to conceal the secrets of programs from prying eyes. Now Atari is resorting to legal action.

Tony Baden of Bug-Byte denies that Vicmen is a straight copy of Pac-Man but he is unwilling to commit limited resources to what might become a long and involved legal battle. "If we had unlimited funds we would like to fight it."

Micros for primaries

WITHIN TWO years every primary school in the land should have a microcomputer. The Department of Industry will supply 50 percent of the purchase cost of a Sinclair Spectrum, BBC Micro or Research Machines 380Z from a £9m fund.

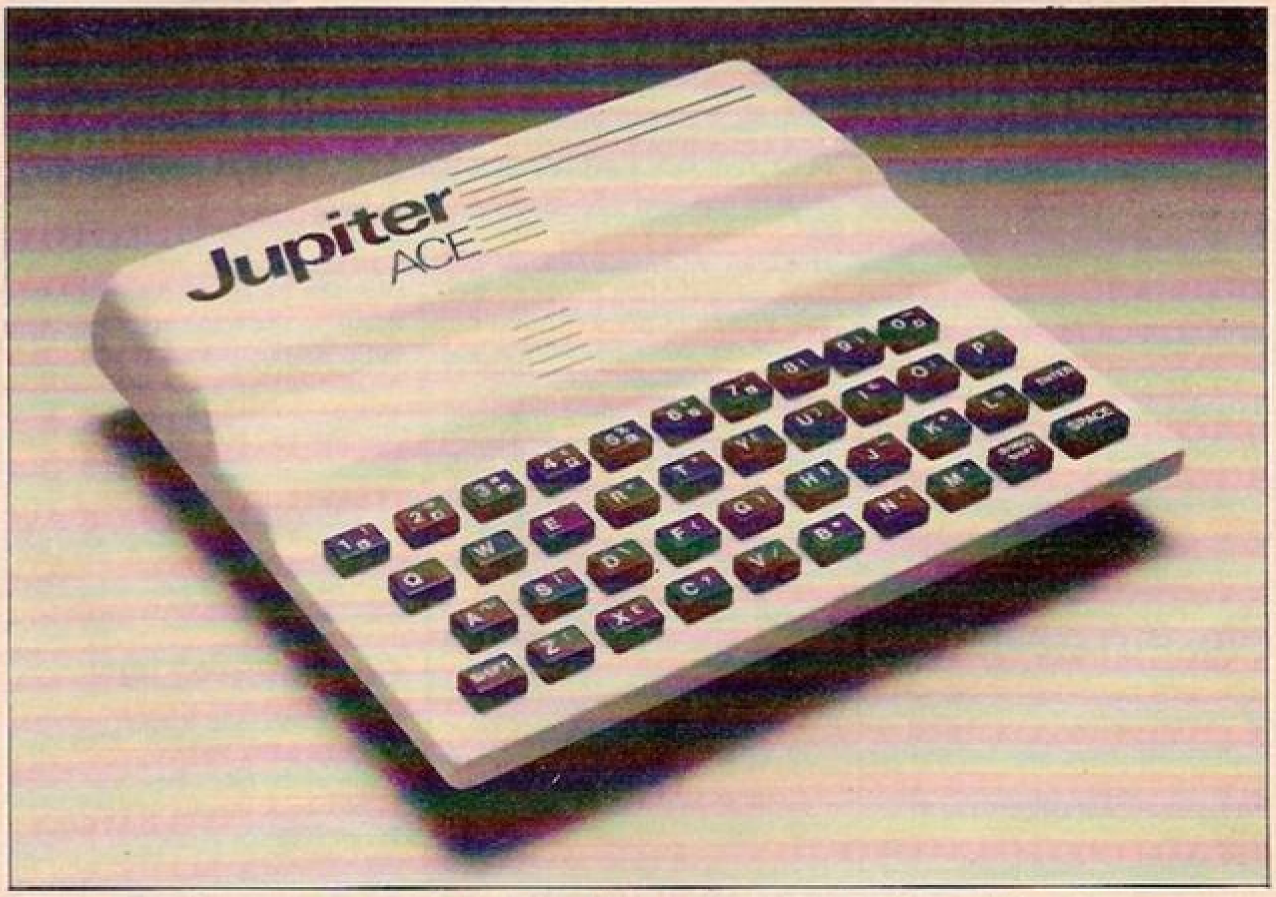
Whereas secondary schools were required to send two teachers on a "computer awareness" course, primary schools will instead receive a pack containing a self-study guide, a microcomputer reader and 20 sample programs on cassette.

Acornsoft has released the first few programs of what is promised to be an enormous range of educational software for the BBC Micro. The initial programs deal with science, mathematics and English language and cost £8.65 per cassette and £13.65 per disc. Acornsoft is at 4A Market Hill, Cambridge CB2 3NJ.

Wordcraft 20 is a Vic-20 version of a word-processor widely used on Pet computers. The system turns the Vic's screen into a window that can be scrolled up, down, left and right over the text. If a typed line is wider than the screen then the window will automatically follow it. The user can manipulate single characters, words, lines or entire blocks. Wordcraft 20, which includes 8K extra RAM, is supplied as a plug-in cartridge for £125 from Audiogenic, PO Box 88, Reading, Berkshire.



Black and white £90 Jupiter Ace goes far faster with Forth



EX-SINCLAIR ENGINEERS Richard Altwasser and Stephen Vickers are launching a new high-resolution black and white computer for £89.95.

The Jupiter Ace will come with 3K RAM and be based around the 3MHz Z-80A. The real surprise though is that the new machine will not use Basic. "We feel that there are many drawbacks to Basic," says Altwasser, "which is why we are using Forth — the language of the future."

Altwasser claims that Forth is easy to learn yet executes far faster than Basic and at the same time encourages a modular approach to programming. This may make the Jupiter Ace particularly appealing to schools, colleges and scientific establishments.

Unlike many recently released machines the Ace will not have colour but sound has been incorporated.

Although the keyboard lacks a full-size space bar Altwasser describes it as a "full-size moving key" and criticises some of his rivals for producing "keyboards that feel like dead flesh — ours will be more positive."

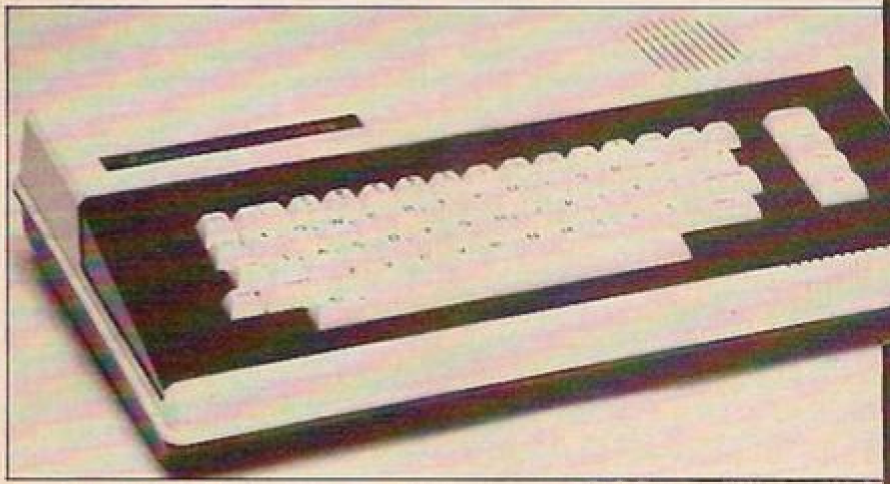
A 1,500-bit per second data-transfer rate should make loading programs from cassette quick and easy. Additional RAM and a printer interface will soon be available as well as a microfloppy drive.

Altwasser claims that the Jupiter can avoid the production delays which have plagued the microcomputer industry by choosing suppliers carefully: "We are not trying to make everything for three farthings." The Jupiter Ace is available by mail order only from Jupiter Cantab, 22 Foxhollow, Bar Hill, Cambridge CB3 8EP.

New Genie conjures up 16K colour and sound

THE ALREADY-CROWDED £200 personal computer market becomes even more cramped with Video Genie's launch of a £199 colour computer. Rob Stead, head of Lowe Computer Division, said "it's a totally new product," not just a colour version of the Genie II.

The Colour Genie, below, offers 16K RAM, a full-size typewriter keyboard, 16 colours, 160 by 96 graphics resolution and 128 programmable characters. Other features include 12K of Microsoft Basic, 40 by 24 characters screen format conforming to Prestel teletext standard, and 1,200 baud transfer rate for cassette. Among the accessories available are a position-detecting light-pen, a printer and, to be released shortly, a Modem facility.





Multitech has 64K micro up its sleeve

MULTITECH HAS joined the £200 computer battle by launching the Microprofessor MPF-II, shown above right, which is to be built in Taiwan.

Whereas six months ago the Vic-20 was the only machine offering colour and sound in this price range, the MPF-II will now have to take on the Colour Genie, the Dragon, the Spectrum, Atari 400 and Texas TI-99/4A.

The MPF-I was a hexadecimal code hobby computer, but the MPF-II is a fully-fledged personal computer. The ZX-81 sized box offers 64K RAM and six-colour high-resolution graphics with sound, based around a 6502 processor and games, education and business software will be available on plug-in cartridges and cassettes. Data can be transferred from cassette at 1,000 bits per second.

The MPF-II will output to any printer with a Centronics interface, and Multitech's own thermal printer will print 40 characters per line at 50 lines per minute.

Other options include a full-sized typewriter keyboard to replace the MPF-II's pocket computer-style keys, a calculator-sized remote controller and a speech synthesiser.

For an additional £100, Multitech has made available a Chinese-character processor which should be useful for translators not to mention Chinese restaurants and small businesses.

Dragon sounds off

IF YOUR DRAGON is a little hoarse or your Spectrum sounds off colour, Computer User Aids new soundboard may be of help.

Musical effects including bass, drums, chords and white noise can be generated on three channels, each with a range of seven octaves. The 1W amplifier can power a built-in speaker or a stereo output. Although the package includes software control for volume, tempo and envelope it does not require user RAM.

The unit costs £29.95 from Computer User Aids, 14 Carlton Road, Romford, Essex RM2 5BD. Telephone 64954.

Information Technology year, which was supposed to bring electronic mail to the people, has been forced to resort to postage stamps to broadcast its message. This is rather as if Caxton had resorted to writing advertisements by hand for his printing press. Those of you who have not made the transition to a paperless society will find that the stamps use more paper than ordinary commemoratives and that with the wonders of information technology it has become necessary to use three frames to display a message which any other stamp could display in one. The right-hand frame of the 26p stamp shows a high-technology supermarket charging someone £23.86 for a can of beans. Both stamps will be available on a specially designed first-day cover at most post offices from September 8.



Sinclair worth waiting for

CLIVE SINCLAIR now admits that many customers have waited 12 weeks for their Spectrums rather than the 28 days still promised in Sinclair's advertising. He claims that production is now running smoothly at 5,000 units per week and that the backlog will be cleared by the end of September.

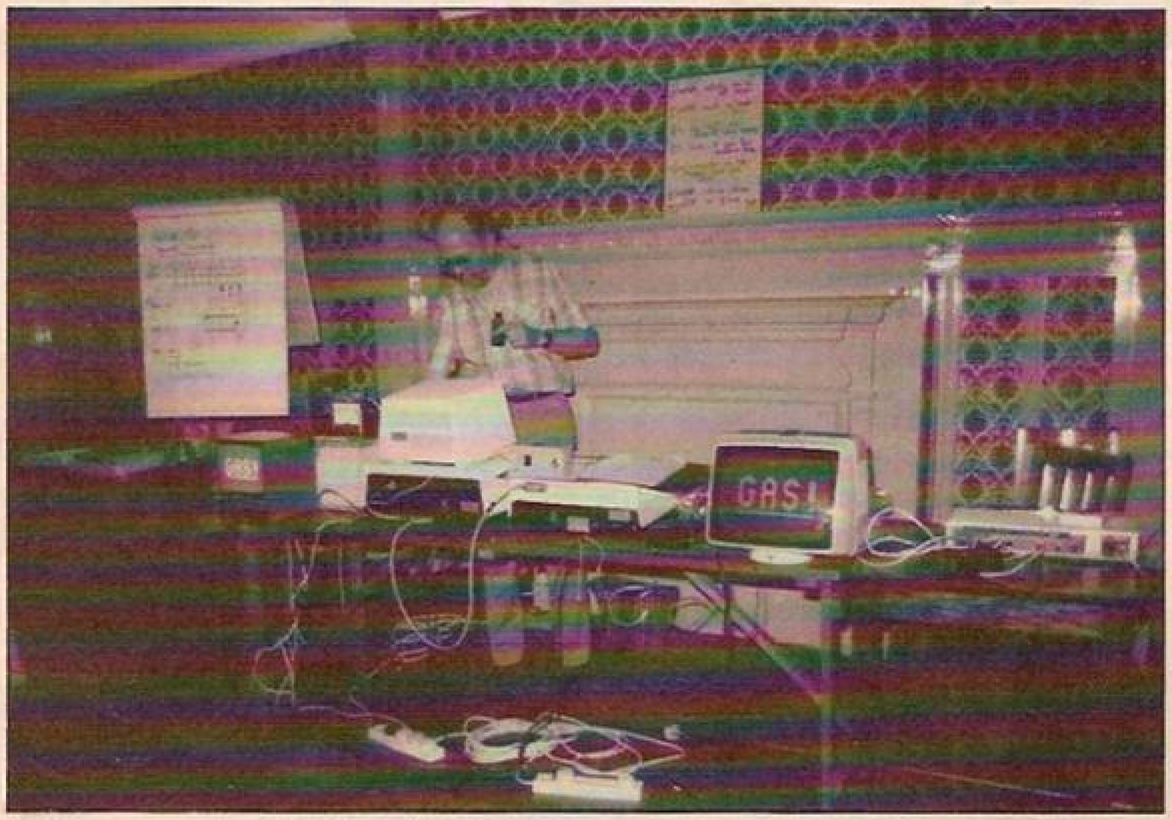
In the meantime those who have given up waiting for the Spectrum can take advantage of recent price cuts to buy a ZX-81 for £49.95 instead of £69.95.

Next year a Prestel adaptor will be made available for the Spectrum. Using the Spectrum as a Prestel terminal, owners will be able to access nearly 200,000 pages of information.

Sinclair will produce the adaptor at a price "well, well under £100". The company will set up a Prestel base of its own and others' programs. Looking further ahead, Sinclair hopes to set up user networks under the Prestel "umbrella", enabling Spectrum owners to talk to each other.

If telesoftware takes off in the way Sinclair anticipates it will, their company's involvement could prove to be a shot in the arm for the ailing Prestel network.

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.



WEST LONDON

Simon Beesley discovers the ins and outs of gas detection and synthesised speech in the convivial atmosphere of the West London Computer Club.

PASS THROUGH the saloon bar of the Fox and Goose, cross the beer garden and you will find the West London Computer Club occupying a room at the back of the pub. Founded almost three years ago, the club recently moved to the Fox and Goose, near Hanger Lane, from Willesden Technical College. The landlord initially billeted them in a smaller room but was sufficiently impressed by their beer consumption to offer them their present spacious accommodation.

As at least half the club's 30 paid-up members are professionally involved in computing, there is a good deal of technical expertise on hand. *Your Computer's* representative soon received advice on how to cure the irritating loudspeaker buzz on his BBC model A and on how to make the screen display steadier. Four BBC Micros were available at the meeting and other machines owned include Nascoms, ZX-81s, a Pet, a Tuscan and a Vic-20.

You do not have to be an expert, or even own a machine, to enjoy the meetings. Neil Cryer, club chairman and co-author with Pat Cryer of a book on programming the BBC computer, pointed out how mistaken it is for people to think they should wait until they buy a computer before joining a club: computer clubs are ideal places to get advice on possible machines.

The August meeting showed the amount of cross-fertilisation that goes on between London clubs. Bazyle Butcher, who had previously given a talk on building a robot arm for £12, attended from the Harrow CC, and David Annal from the Croydon CC gave a talk that evening on "The Ins and Outs of Interfacing".

The talk mixed technical information on interface chips with a variety of practical demonstrations. Using three monitors linked up to a Pet, he showed how to input information to the computer from a torch via a light-detecting cell, a light-pen, a microphone and a device which detected gas and interrupted a program with an alert. Among the output possibilities demonstrated was an impressive example of synthesised speech, using a "phoneme speech" chip.

The chip can interface with a computer and an amplifier to produce 36 different vowel sounds, 25 consonants, three types of pause and four inflections. These can be combined to synthesise almost any spoken word. Inflections — a voice's rise and fall — make the difference between monotonous "robotic" speech and a more human-sounding voice.

In a virtuoso programming application, David Annal's speech generating program recited the verses of his poem, Sam, which relates the misadventures of a young lad, Sam, in rhyming couplets. In time with the recital, the program displayed some high quality graphics on the monitor illustrating episodes from the poem and printed the verses at the top.

The club arranges a talk by a member or guest for most meetings. In September, Graham Brain — one of the founder members with Bernie Haylett — will talk about the Pluto colourboard, and in October there will be a talk on CP/M. Meetings take place on the first Tuesday of every month at the Fox and Goose, Ealing Road, West London. For further details telephone Neil Cryer, 01-997 9437, or Bernie Haylett, 01-883 3948.



Local news

Bristol

BRISTOL Computing Club is offering a course in Basic programming from September 15. The club meets on the third Wednesday of every month at the University of Bristol Physics Building. More details from the club secretary on 0454-322071.

Cheshire

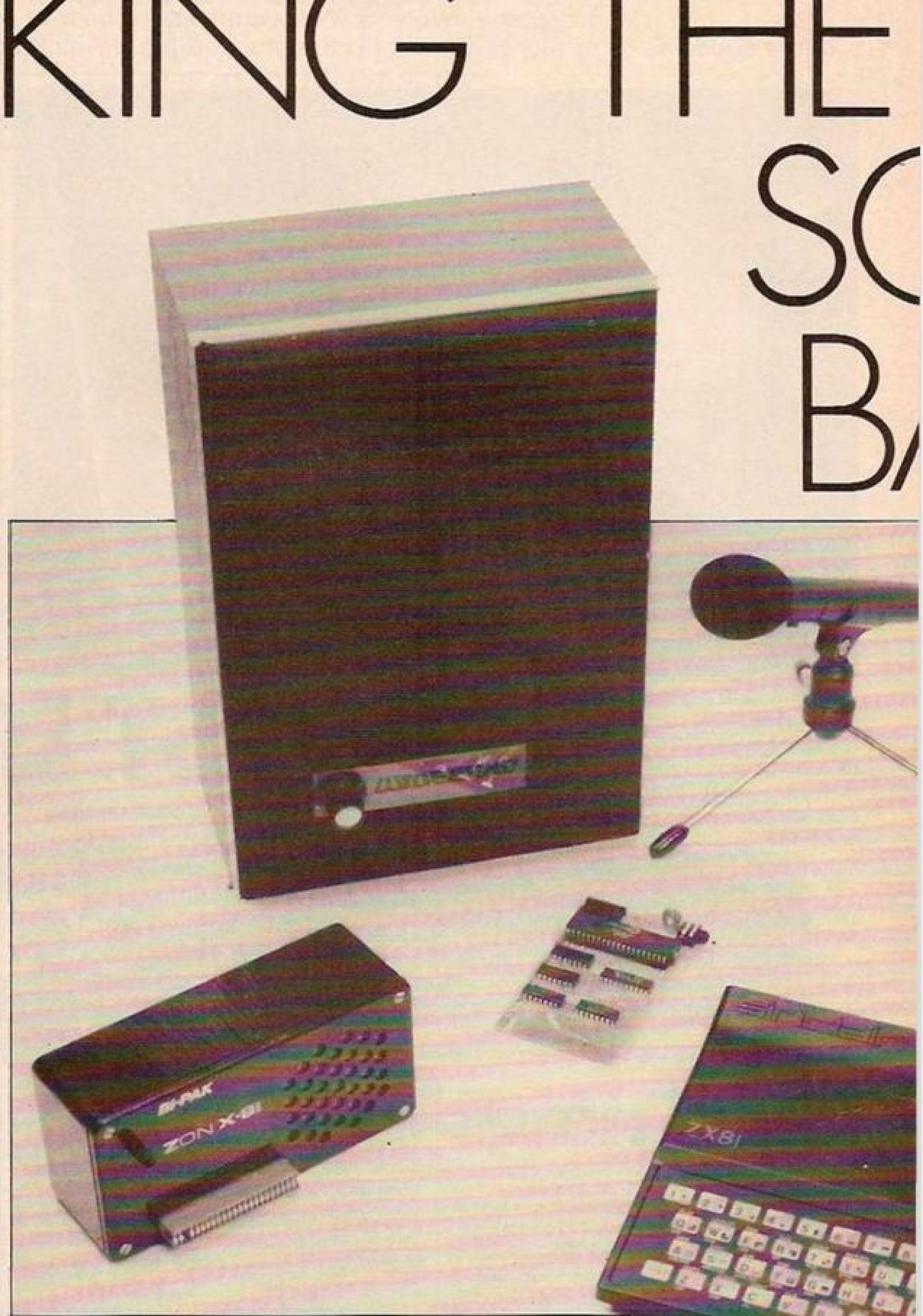
MEETINGS of the Mid-Cheshire Computer Club are held at the main Winsford Library on the second Friday of each month. They usually include a machine demonstration in the proceedings. Telephone Dave Clare on 06065-51374 for more details.

Newcastle

NEWCASTLE Personal Computer Society has been running since 1978. They are linked with several user sub-groups. Meetings take place on the first Tuesday of the month at Room D103, Ellison Building, Newcastle Polytechnic. You can telephone John Bone on 0632-770036 in the evening.

BREAKING THE SO BA

Once upon a time computers that could talk and listen were only found in *2001*. Now Tim Langdell looks at devices that could make your ZX-81 come alive — from the humble keyboard bleep to mighty units that can recognise and synthesise speech.



PERHAPS THE most frequent criticism made of the ZX-81 is its unresponsive keyboard. Except for the eagle-eyed, it can be very difficult to be sure that the key pressed has been accepted by your '81. This can be especially frustrating when you are entering large amounts of data or machine code. A keyboard beeper can be a Godsend in situations like this, and the two I tested are the Keyboard Audio Tone from TV Services of Cambridge, and the Fulcrum Electronics Bleep.

Fulcrum's Bleep is the simpler of the two devices and once fitted, pressing almost any key on your ZX-81 will cause a beep. The board is extremely easy to attach and requires no soldering. Ingeniously, Fulcrum has used small, spring-loaded pins on the ends of the leads to be attached to the ZX-81's circuit board.

Keyboard response

There are clear instructions to explain into which holes in the circuit board the pins are to be pushed. They explain in detail how to open your ZX-81 and how to reassemble it safely. The Bleep's board and piezo-buzzer fit neatly inside the ZX-81's and can be held in place with sticky tabs.

From the 210 characters and keywords possible on the ZX-81, the Bleep will give a noise when any of 198 of them are pressed. The key presses which will not produce a beep are such keys as Edit, Rubout, Newline, Function and Space.

As Fulcrum points out, the fact that there is no beep when these keys are pressed can be useful in drawing your attention to the action you are taking. If only someone could devise a way of giving extra warning when New is pressed.

I have just three minor criticisms of the Bleep. First, because attaching it involves taking one of the ZX-81's fragile keyboard ribbon cables out of its socket and putting it in Fulcrum's one, you will need to be extra careful not to crease the cable. A small break in the ribbon cable can give rise to rather annoying and intermittent problems — keys suddenly fail to work.

Secondly I found the beep sound rather tiresome after a while. It would have been useful to be able to switch off the Bleep when not required. This extra facility would be particularly useful to owners of ZX-81s with larger keyboards fitted where the beep would not always be needed.

Lastly, it would be unwise to assume that if you heard a beep with this board that your ZX-81 has definitely noted your keypress. ZX-81s are relatively slow machines and even with the poor standard keyboard it is not difficult to out-type them.

The Keyboard Audio Tone is a little more sophisticated in that it not only gives a beep when any key is pressed — and all keys give a beep — but it also gives a different toned beep when the ZX-81 is ready for the next piece of information.

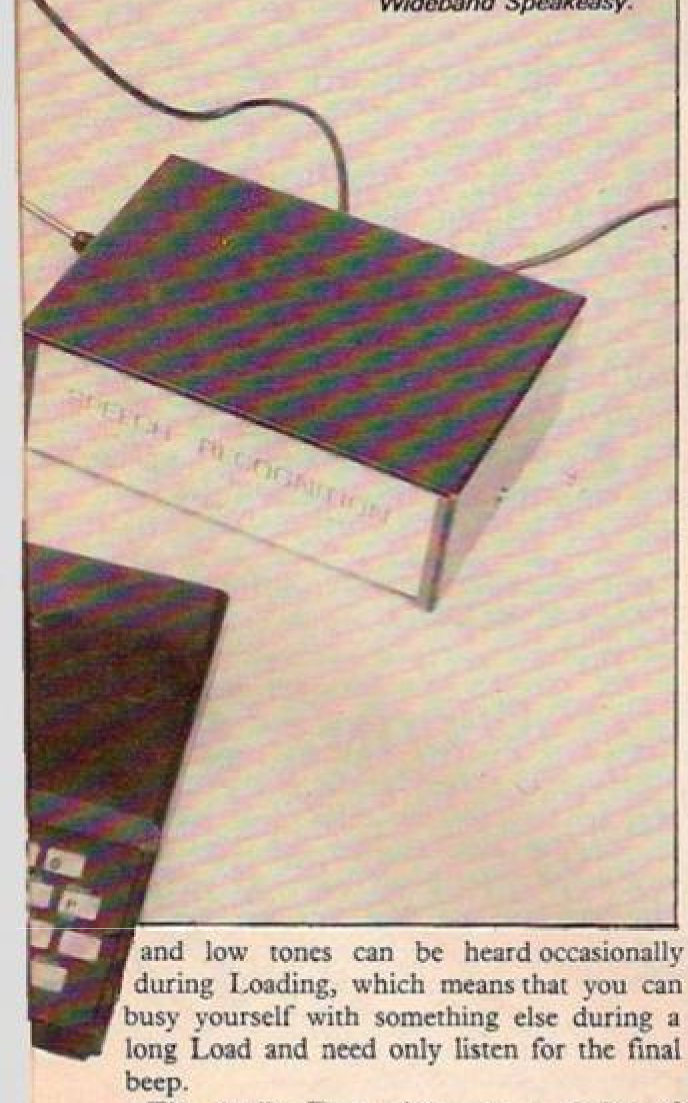
Fitting this device does, however, require some soldering. Five wires must be carefully soldered to the ZX-81's printed-circuit board and very clear instructions are given on how to do this.

As with the Bleep, the Audio Tone is fitted neatly inside the ZX-81's case with sticky tabs. In use it makes working with your ZX-81 more like talking to R2D2. Every key press gives a low tone, and you hear a high tone as soon as the ZX-81 has executed the command. This can be particularly useful when working in the Slow mode. If you grow accustomed to listening to the two tones you will never out-type your '81.

Choice of loudness

This device also gives rather useful feedback when loading programs. At the end of a Load the beep sounds to indicate that the ZX-81 is ready for the next command. Also, the high

ZX-81 OUND ARRIER



Right and cover: Fulcrum's ZX-81 bleep and William Stuart's sound synthesiser. Below: Big Ears speech recogniser, Quicksilva sound board, Zon synthesiser and Wideband Speakeasy.

and low tones can be heard occasionally during Loading, which means that you can busy yourself with something else during a long Load and need only listen for the final beep.

The Audio Tone gives you a choice of volume levels, too. You can make the tones louder by changing the position of a wire link on its printed-circuit board. In fact, it would be possible to attach a two-way switch with a centre off position so that you have the choice of loud or quiet tones or no beep at all.

Finally, a very useful feature of this device is that you can introduce a beep into a program by simply putting a Pause of greater than about four. This could provide a simple way of introducing sound to your games programs.

Comparing the two keyboard beepers is not easy. Both do their job well and would be a cheap but extremely useful addition to a ZX-81. My own preference was for the Audio Tone because it offered more facilities at no extra cost — they are both £8.95.

Sound synthesiser boards are also available for the ZX-81, and for around £20 you can add laser sounds to your space invader games, or play your ZX-81 like an organ. There are three sound synthesisers on the market at present: the Quicksilva sound board, Stuart Systems Sound Synthesiser, and Zon-81 from Bi-Pak.

The Bi-Pak uses the versatile AY-3-8192 chip whereas the other two devices use the very similar AY-3-8190 sound synthesiser. Hence all three devices offer very similar facilities. The two AY-3-8190-based ones also offer two eight-bit ports as well as the sound synthesis, whereas the Bi-Pak synthesiser offers only sound.

Creating specific sounds

A further major difference is that the Bi-Pak and Stuart Systems boards are not memory-mapped in RAM space: they are in the I/O area of the Z-80A's memory, whereas the Quicksilva board is mapped at the top end of the 16K RAM area.

Finally, the boards differ in that the Quicksilva and Stuart Systems boards must be attached to an amplifier whereas the Zon-81 is a fully self-contined unit with amplifier and speaker.

A disadvantage with all three devices is that it is not obvious how one is to obtain a specific sound. A relatively simple gunshot sound, for instance, can take up to 20 lines of program. Forewarned, however, that you may have to devote some time to creating a new noise, these boards can produce an amazing variety of sounds, from steam trains and laser shots to music in three voices in imitation of almost any musical instrument. The three sound synthesisers are supplied with differing amounts of information, which in each case is inadequate.

The Stuart Systems synthesiser is available as a kit as well as ready-made. The instructions on building the kit were very clear and if you have had some experience of building electronic circuits you should find building this device relatively easy.

Because the synthesiser is in the Z-80's I/O area and not memory-mapped in the RAM area it cannot be addressed from Basic with Peek and Poke commands. Instead, a machine-code routine has to be used.

Stuart Systems gives clear instructions as to how to load the routine which is about 100 bytes long and held in a Rem statement. You would need to enter this machine code only once and then save it on cassette for the next time.

Stuart Systems gives an overview of how the AY-3-8910 chip works. This will probably take you a few readings to understand fully, but it is, however, reasonably clearly written.

The booklet with the synthesiser covers how to select the various registers in the chip with which you can choose what type of sound will be produced. The several examples given help you understand how the device works, but it



would have been better were there more specific examples of how to obtain sounds you might typically use in games. The only real example of this kind produces a slow steam-train sound.

At the end of the booklet Stuart gives some ideas as to how the output port might be used. Several hardware ideas are offered and information as to the maximum loads which can be applied.

Stuart Systems also offers a Music Composer program on cassette for an extra £6.90. This allows you to easily enter tunes with up to three-part harmony, and allows easy setting of volume, pitch, and decay of each note. The cassette is complete with two demonstration tunes. If you are interested in composing tunes then this cassette could be good value, but you must have a 16K RAM to run the program.

To hear the sounds you create you have to attach your Stuart Systems board to an amplifier. This aspect of the synthesiser is poorly documented, and if you were to read the booklet too quickly you might be forgiven for thinking that the sound comes from your TV's speaker, which it does not.

Speaker systems

Stuart Systems suggest in a diagram that you attach one of the three outputs to one channel of a stereo amplifier, and another to the other channel. However, there is no reason although Stuart Systems omits to say so, why you should not attach all three outputs to a mono-amplifier.

The Stuart Systems board is well made and has a duplicate connector at the back so that a 16K RAM pack or another add-on can be fitted at the same time.

The Quicksilva sound board is similar in many ways to Stuart Systems device. One major difference, though, is that the Quicksilva

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board must be used along with Quicksilva's motherboard or one of similar specifications. The only alternative is to use two edge connectors soldered back-to-back, which Quicksilva also supply. Whichever of these two methods you choose, you will have to pay extra on top of the price of the sound board.

As with the Stuart Systems board, Quicksilva does not make it clear that you have to connect the board to an amplifier, or that this connection is made via a 3.5mm. socket at the top of the board. However, the documentation shows that you can alter the output volume of the board to match your amplifier by turning a small potentiometer adjacent to the socket. Unlike the Stuart board, then, the Quicksilva one is designed to work with a mono-amplifier.

The Quicksilva board's sheet of information gives a brief idea of how the 13 registers in the AY-3-8910 work to produce various sounds. Addressing each of the three music channels is covered as well as how to address the noise channel and create envelopes.

Music programs

Unlike the other two sound synthesisers, this board simply requires you to Poke two locations — 32767 and 32766 — to produce sounds and control the chip. A useful table is provided which enables you to create accurate scales over a five-octave range.

Quicksilva provides a few more example programs than Stuart Systems, and these include a program to play a simple tune, and a phasor-effect sound. The phasor sound is reasonable, but I am sure with perseverance you can produce a sound more like an arcade game's.

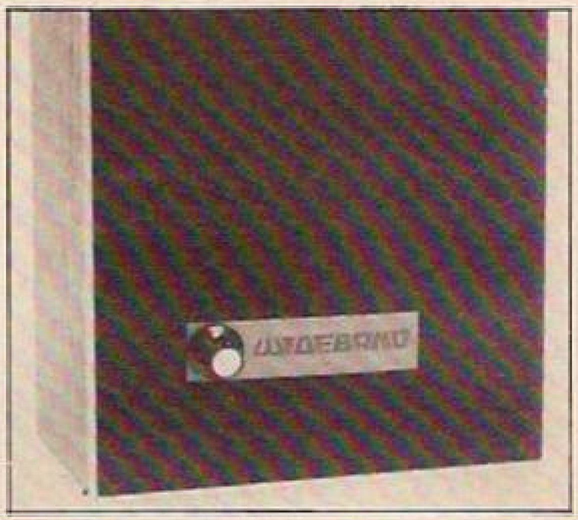
Quicksilva gives very little information on connecting hardware to the two user ports other than to say they can be connected up via the on-board 16-pin DIL socket.

The third sound synthesiser is from Bi-Pak. It is supplied in its own black plastic box, with integral speaker, amplifier and volume control. As such, it is much less fuss to set up than either of the other two boards. The booklet provided with it was also more comprehensive and, on the whole, well written.

Apart from summary tables indicating what each register does and a visual idea of the envelope shapes, which both the other board's information included, this booklet was the most informative and easy to read of them all. It gives clear instructions on how to enter the nine-byte machine-code routine which is needed to run this non-memory-mapped device. The Stuart Systems board routine needed 100 bytes.

The booklet's approach is a hands-on discovery of the AY-3-8912 chip's functions, which are identical to those of the AY-3-8910. It is not perfect — you still have to work hard to create any given sound — but it is well written. The booklet contains example programs, all of which are useful. However, the phasor sound Bi-Pak suggests is too much like a simple gun shot.

There is also a program to allow you to use the keyboard of your ZX-81 as an electronic organ. An assembly language version of the machine-code routine is included — which Stuart Systems omits — as well as an idea of how the chip does its job. The unit does not include a user port like the other two boards, but many of you may feel that this is not an essential feature anyway.



The Zon X-81 also has a rear edge connector which duplicates the one on the rear of the ZX-81 and thus allows you to have a RAM pack fitted at the same time.

If you want a sound synthesiser and an I/O port then you may well be advised to choose either the Stuart Systems or the Quicksilva board. This should be slightly less expensive than buying a separate I/O port as well.

However, both of these boards presented the problem of needing to be connected to an external amplifier which may not always be easy — my own stereo system is not usually within reach of my ZX-81, and vice versa. The Bi-Pak was easier to use for this reason, and had the clearest guide to using the sound synthesis chip.



Top: Wideband Votrax-based speech synthesiser. Above: Zon-81.

As far as price is concerned, the Stuart Systems board is the cheapest at only £19.50 plus VAT in kit form, and £25.50 plus VAT ready-made. The Quicksilva board is £26, but remember that you will either also need a QS connector at £4 or a motherboard at £12. Finally the Bi-Pak Zon X-81 is £25.95 including VAT. This means of course, that it is the cheapest of the three in ready-built form, even though it is supplied boxed and with its own amplifier and speaker.

Art of conversation

You can also make your ZX-81 speak to you. There are two main types of device on the market which can achieve this. One type uses the Digitalker technique which has a vocabulary in digitised form stored on ROM. The Digitalker device on the market at present for the ZX-81 is the Speech Pack from DCP. This device is mapped in RAM at locations 49149, if you have just the ROM supplied with the Speech-Pack, and 49148 if you buy further ROMs.

Using the Speech-Pack is very easy and only requires Poking the location in question with a code number given to the word you wish played. A full table of words and their codes is given. There are four ROM word-packs available, but only the first is supplied with the Speech-Pack. This first ROM contains 72 words, giving all numbers from 1 to 19, the tens from 20 to 90, 100, 1000 and 1,000,000.

Phenomenal phonemes

The letters of the alphabet are also on this ROM — Z is pronounced "zee" — as well as a few words of dubious use such as ampere, case and cent. Clearly, it is an American chip. Rather more useful are the two tones of different pitches which can be sounded during a program as part of a game or whatever. As it stands this first ROM does not appear very useful, and further ROMs cost about £15 each.

The unit is very easy to use, and the words are clear. It is boxed and contains an internal speaker/amplifier. The ZX-81's rear connector is duplicated at the rear of the unit, and facilities to alter the volume of the speech or attach an external speaker are available.

DCP has also just released a Spectrum adaptor which allows the unit to work on a Spectrum using the In/Out commands. DCP has mapped the unit in the Spectrum's I/O area, and so it does not interfere with memory.

However, be warned that the Spectrum's rear connector is not duplicated at the rear of the unit. Any other add-ons, such as the printer, must come between the Spectrum and the Speech-Pack.

The main alternatives to the DCP Speech-Pack are the Votrax-based devices which actually synthesise speech. This chip, which is also American, does not have words stored in ROM like the Digitalker, but instead is capable of producing all the phonemes present in speech. Words are thus built up by continuing several of these phonemes. You can think of the phonemes as being small sound units such as the "-er" at the end of "butter" or the "doh" at the start of "dog".

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There are several such devices on the market: the Wideband, the Voxbox from Mutek at £65, and the Namal Supertalker 1 at £49.95 plus VAT from Namal Associates. The Wideband and the Voxbox are very similar.

The Wideband is encased in a bookshelf speaker box, and has its own amplifier, speaker and power supply. The Wideband is connected to your ZX-81 via a cable and a parallel port. Any parallel port for the ZX-81 should work, but you do need to buy one.

While the Wideband manual is long and generally well written, it does not help you very much with regards attaching the unit to a ZX-81. There is just one page devoted to this which uses the DCP I/O port as an example, but no explicit directions are given.

In fact you need to connect up data lines 0 to 7 on your parallel port to the pins on the Wideband's connector as indicated in the manual. But only the Strobe signal should go to the D7 line. The other D7 they mention for a Busy should be attached to D7 of an input port. It is easy to get this confused from Wideband's literature.

The Votrax chip needs to receive a Strobe signal telling it that message is now on the data lines, much as a printer does. Wideband tells you to use D7 for this and to include Pokes to D7 — by Poking the port location with 128 — to simulate a Strobe signal. While the Votrax chip is producing the sounds, it sends a Busy or low signal to the D7 line of your input port which needs to be tested by a line in your program. Only when this line goes high again, should you try to make the Wideband produce another phoneme.

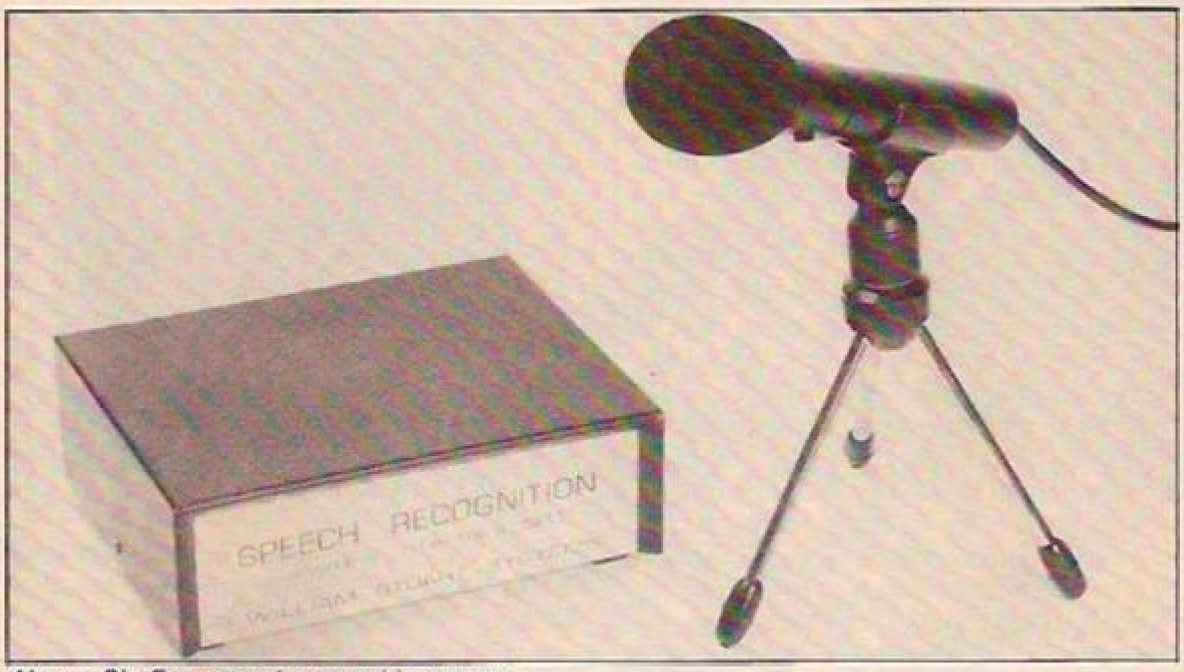
Once you have grasped these simple rules, programming the Wideband is relatively simple. The Wideband has a long word list with suggested phoneme combinations for each word. The watchword though is to experiment for yourself — you can even produce regional accents.

However, unless you are a linguist programming your own words will take a good deal of time and thought. Wideband offers a phonetic-input program which I would strongly recommend anyone buying the unit should obtain. This program is designed to allow you to enter words more in the form that they are spelt and it decides which are the appropriate phonemes.

The main problem is that the voice is all one pitch, and so sounds rather like a Dalek from *Dr Who*. In general the sound quality is poorer than with the Digitalker system, but there are no limits to the number of words you can produce. This unit can be fun to use and could easily provide an interesting added dimension to games.

The unit has both a volume control and a pitch control to alter the sound from a deep man's voice to a high-pitched man's voice — curiously, it never sounds like a woman's. This pitch control is rather difficult to access and any adjustment involves you in sticking a screwdriver through a hole in the rear of the unit.

A final criticism must be the rather annoying hum that the unit produces. The Voxbox, which has an external knob to change the pitch, hums less. Perhaps Wideband could improve this aspect by changing the smoothing



Above: Big Ears speech recognition system.

capacitors. By the way, do not be surprised if you order a Wideband, or a Voxbox, and receive a cable with it marked "Pet". Wideband does not make up cables for ZX-81s because there are so many different I/O ports available for the machines.

Comparing these two rather different methods of allowing your ZX-81 to talk seems rather unfair as they rely on such different principles. However, a fully expanded DCP Speech-Pack will cost around £95 — the basic unit with one ROM is £49.95. On the other hand the Wideband is complete at £69 plus VAT. You do need a parallel port for it, though, which would typically cost you a further £15 or so. The Voxbox sells for around £65. On the whole the Votrax-based units seem better value for money, but the Digitalker has clearer speech and its vocabulary can be sufficient for many purposes.

The final device in this survey is a Speech Recognition system from William Stuart Systems. This is also known by the unfortunate name Big Ears. This is a very sophisticated piece of equipment allowing your ZX-81 to respond to your spoken commands. The Speech Recognition System (SRS) is housed in its own well-made metal cabinet with plug sockets for a microphone and a connector to attach the unit to an I/O port. You can use any parallel port, but you will need one to be able to use the SRS.

A good-quality microphone is supplied with the unit, as is a cable for connection to the sound board. The connections are simple to make, and there are copious notes. Stuart Systems provides a theoretical article on the subject, written for other machines, but intelligible to ZX-81 owners too.

The SRS is very fussy about setting up and use. You must set up in a quiet room, and talk in a loud voice about a foot away from the microphone. The quality of your voice also has to be consistent or else the SRS will not recognise you. Stuart Systems now supplies a program on cassette which makes setting up the SRS very simple. Whether you use this tape or the other method involving the lengthy program included in the SRS's instructions, you will have to speak each word into the system several times while it learns your voice pattern.

This device certainly works and can be fascinating to experiment with. But it is rather sensitive to changes in your voice, room noise, and so forth. For such reasons, and the fact that it is particular about the way you speak, it is difficult to see this unit being in everyday use with ZX computers. Uses it would be ideal for — such as being able to say "fire" in a space invader-type game — are not really suitable for this unit as it stands.

All in all, if you are interested in speech recognition then you will be delighted with this unit. But if you want a simple futuristic device to enable you to talk to your ZX computer rather than type in words, then I think you will have a little while to wait yet for such a piece of cheap electronics. The Stuart Systems Speech Recognition System costs £49 plus VAT. ■

Keyboard beepers

- *Keyboard Audio Tone,* TV Services of Cambridge Ltd., Chesterton Mill, French's Road, Cambridge CB4 3NP. £8.95.
- *ZX-81 Bleep,* Fulcrum Products, Hillside, Steep Lane, Findon, Worthing, West Sussex. £8.95.

Sound synthesisers

- *Zon X-81,* Bi-Pak, PO Box 6, 63A High Street, Ware, Hertfordshire. £25.95.
- *Stuart Systems Sound Synthesiser,* William Stuart Systems Ltd, Dower House, Billericay Road, Herongate, Brentwood, Essex. £19.50 kit, £25.50 built, plus VAT.
- *Quicksilva Sound Board,* Quicksilva, 92 Northam Road, Northam, Southampton. Sound board £26, Motherboard £12 or QS connector £4.

Speech synthesisers

- *DCP Speech,* DCP Microdevelopments, 2 Station Close, Lingwood, Norwich. £49.95 and £14.95 each extra word ROM.
- *Wideband Speakeasy,* Wideband Products, Cambridge Road, Orwell, Royston, Hertfordshire. £69 plus VAT.
- *Voxbox,* Mutek, Quarry Hill, Box, Wilts. £65 including demonstration software.
- *Namal Supertalker 1,* Namal Associates, 25 Gwydir Street, Cambridge. Tel: 0223 355404.

Speech recognition

- *Big Ears,* William Stuart Systems Ltd, Dower House, 7 Billericay Road, Herongate, Brentwood, Essex. £49 plus VAT.

SURVEY

SPECTRUM SOFTWARE

Boris Allan examines the first software offerings designed specially for your Spectrum.

ALTHOUGH THE SPECTRUM was announced in April the machine has only become available in large numbers recently. For software suppliers it is still early days. We were therefore relieved to find that most of the programs we received worked first time and reasonably well even if some of them lacked originality.

Most of the software we sampled was based on ZX-81 or arcade games but we also tried out some educational and utility programs. Loading the Spectrum was far less frustrating than the ZX-81. The machine performed well, producing particularly good colours but disappointing sound. The limitations of the internal speaker can at least be bypassed by taking the cassette out of the recorder, connecting the two Mic sockets and switching on the recorder. Tone and volume can then be controlled with the recorder's own controls.





Above: Chromasoft's Bomber. Right: Bug-Byte's Spectral Invaders.

Games programs are strange things. Long complex programs can be much less enjoyable than a short snappy one incorporating a good idea. So long as the programs are relatively bug-free, as most of these Spectrum games were, then evaluation of any particular cassette is bound to be subjective. To give as objective an assessment as possible we tried out the games on all age groups — even a class of five-year olds.

Both Bug-Byte's Spectral Invaders and Quicksilva's Space Invaders approach the standard of real arcade games. Spectral Invaders is almost an exact copy of Space Invaders, complete with four different colours for invaders, a flying saucer and high score. Some effects are slightly slower than the Atari original but the graphics quality and the use of colour and sound is excellent. Quicksilva's Space Intruders also had a mutant invader that wobbled and was worth extra points and a hold facility to allow you to stop the game at any point.

While the invader programs were written in machine code, Alien Command was written in Basic and was too slow and crude for a space game. Winged Avengers from Work Force is a Galaxian-type game in which waves of attackers move down the screen towards the player's missile firer, break formation, circle about and then attack again. Six speeds are offered and the action is fast. But with the exception of a formation of birds, which appear in the second attack phase flapping their wings very effectively, the display is a little dull.

Chromasoft's three programs varied from



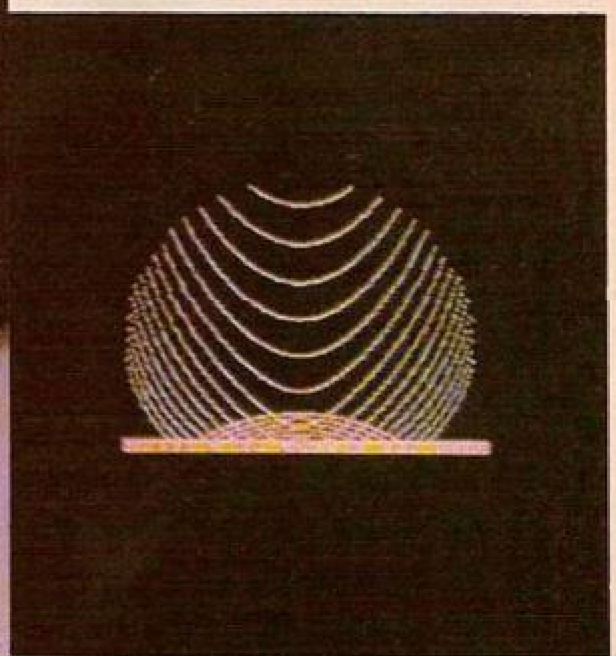
the sublime to the ridiculous. Worm is a simple but clever idea. A worm on the screen has four segments, and the player has to direct the worm around the screen, eating up numbers. Each time a number is eaten, they flash up randomly, the length of the worm increases by that amount. As the worm gets longer, it becomes more difficult to navigate, because you are not allowed to leave the screen or to cross over yourself. One player reached about 125 segments, and could not find any space.

The program is as simple as the display but the idea worked. Defined colours and graphics for the segments would be improvements but only cosmetic. Bomber is an uninspired rendering of Blitz. Golf is not only unexciting but bug-ridden. Amongst other things the game was unwilling to play the right number of holes.

AVC's Fortune could be a useful stand-in for the crystal ball at children's parties. The company's Tables has a more educational objective. The tests of multiplication tables are quite competent but the program would be more useful as a means of generating interest and enthusiasm for mathematics rather than for teaching the tables themselves.

Whoever designed it has a keen appreciation of the minds of primary school children, although AVC is stretching a point when it claims the program can be used to the age of 16. One clever ploy to generate interest was the use of the ZX-Printer to give each child a permanent record of its achievement. One kid described it as "space-age paper". This theme is reinforced by a countdown to the launch of a rocket each time you play.

Time Bandits from Newsoft comprises six separate games on side 1 all combined in an



Phantasmagraphics

Adventure-style game on side 2. Most of the games have pretty graphics but are rather elementary. Minotaur's Labyrinth is a matter of collecting objects in a maze and Napoleon's army is similar — but without the maze. In Titanic you rely on luck to avoid being sunk by an iceberg while Tower of London is at least distinguished by the appearance of random Beefeaters. Combination is just a matter of remembering a number but Castle of Evil is a little more out of the ordinary.

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You have to work out the best strategy to cross a web with hostiles converging on you — rather like the Adventure game which used to be shown on BBC 2. Most of the games had not been carefully thought out. It was sometimes possible for instance to offer bribes of minus amounts of money, and thus become richer.

Backgammon from Keith Archer worked well enough but was easy to beat and again vulnerable to cheating. There was nothing to prevent you putting more than five counters on a point for instance.

Richard Altwasser's Cambridge Colour Collection costs £9.90 for a book of 64 pages and a cassette. Though some of the programs are original, in that they use specific features of the Spectrum, many are not: Maze is marred by a poor algorithm. There is also Breakout, Nim, and most others, including a version of King called Kingdom. The cassette was unfortunately unloadable — the company has had to replace many of the cassettes.

We reviewed two graphics packages. Phantasmagraphics plots 2D and 3D patterns and allows you to modify the patterns by entering height, width, perspective and distortion variables. The program is written in Basic and takes up to six minutes to draw a shape. The program contains a bug which causes it to be interrupted by an "integer out of range" error message for large height and width values.

Superdraw 16 is an exceptional program. For £5 you are supplied with an instruction booklet, a pad of screen design pads, and a cassette with a spoken commentary on one side, all in a polythene bag. No other program gave such value for money. The program is written in Basic and allows the user to design screens which can then be saved for incorporation in other programs, which make use of high- and low-resolution graphics, text, and user-designed alphabets of large letters. The "slide-show" option automatically loads successive screens. High-resolution pictures of a bicycle and southern England among others flash up in turn very much like a slide-show for the unemployed.

Two simulation games are available from Case Computer Simulations. Autochef allows you to work your way up as manager of a small catering company. At first you have to avoid being taken over by Trust House Forte — later if you survive you can try to take over Forte yourself. Airline is exactly the same as Autochef except that you are running a small airline.

The two assemblers were useful because they save you money by not buying at inflated prices books which disassemble the Spectrum ROM. Of the two the Campbell version is more attractive as it is written in Basic, and one can learn from studying the program listing — warts and all.

The Artic version was difficult to follow, as the documentation had not been prepared, but if the Spectrum documentation is as good as the ZX-81 documentation then it will be terrible. Given the incomplete nature of both offerings, the cheaper price, and the ability to convert from hex to dec and vice versa, sometimes with amusing results, the Campbell Systems offering may be better value. ■

Firm	Program (Type)	Comments	Price
QS	Space Intruders (I/W)	High quality invaders	£5.95
C	Worm (RTC)	Addictive, yet simple	£4.50 for all three games
	Golf (O/M)	Badly written, poorly debugged	
	Bomber (I/W)	A bad version of a good idea	
JS	Alien Command (I/W)	Far too slow	£5.50
NP	Secret Valley (A)	Has potential. Sound is poor	£4.95
	Time Bandits Side A		£4.95 for Side A and Side B
	Minotaur's Labyrinth (O/M)	Too easy	
	Napoleon's Army (RTC)	Too easy	
	Titanic (D)	Tiresome	
	Tower of London (O/M)	Too easy	
	Combination (D)	Any fool can do	
	Castle of Evil (L/M)	Best of the bunch	
	Time Bandits Side B	All the games from side A, randomly chosen except Combination	
KA	Backgammon (IG)	Reasonable, but not very intelligent	P.O.A.
CCS	Autochef (D)	Spelling terrible, and a poor simulation	£4.75
	Airline	A very poor simulation	£4.75
AVC	Fortune (D)	Keeps children happy, possibly useful for events	£3
	Tables (D)	Useful	£3
VSL	Superdraw 16 (U)	Excellent, incredible value for money	£5
ACL	Spectrum Bug (U)	Passable only	£6.95
CS	SPDE Disassembler and Editor (U)	Reasonable, some small problems	£5.95
BB	Spectral Invaders (I/W)	Very good	P.O.A.
WF	Winged Avengers (I/W)	Galaxian	P.O.A.

Suppliers

Firm	Name and address
QS	Quicksilva, 92 Northam Road, Southampton SO2 0PB
ACL	Artic Computing Ltd, 396 James Reckitt Avenue, Hull, North Humberside
KA	Keith Archer, ZX Computer Centre, 17 Sweeting Street, Liverpool 2
VSL	Video Software Ltd, Stone Lane, Kinver, Stourbridge DY7 6EQ
AVC	AVC Software, PO Box 415, Harborne, Birmingham B17 0HD
CCS	Case Computer Simulations, 14 Langton Way, London SE3 7TL
C	Chromasoft, 202 Lower Addiscombe Road, Croydon CR0 7AB
JS	Jega Software, 27 Hallcroft Avenue, Countestorpe, Leicester LE8 3SL
NP	Newsoft Products, M Newman, 12 Whitebroom Road, Hemel Hempstead, Hertfordshire
BB	Bug-Byte, The Albany, Old Hall Street, Liverpool L3 9EP
WF	Work Force, 140 Wilsden Avenue, Luton, Bedforshire

Notes: In the category column the following abbreviations have been used: O/M, obstacles or maze game; B, break-out type game; RTC, game with real-time control; I/W, space invaders-type or war game; IG, intelligent games; L/M, logic or mathematical programs; D, demonstration programs; U, utility; A, adventure.

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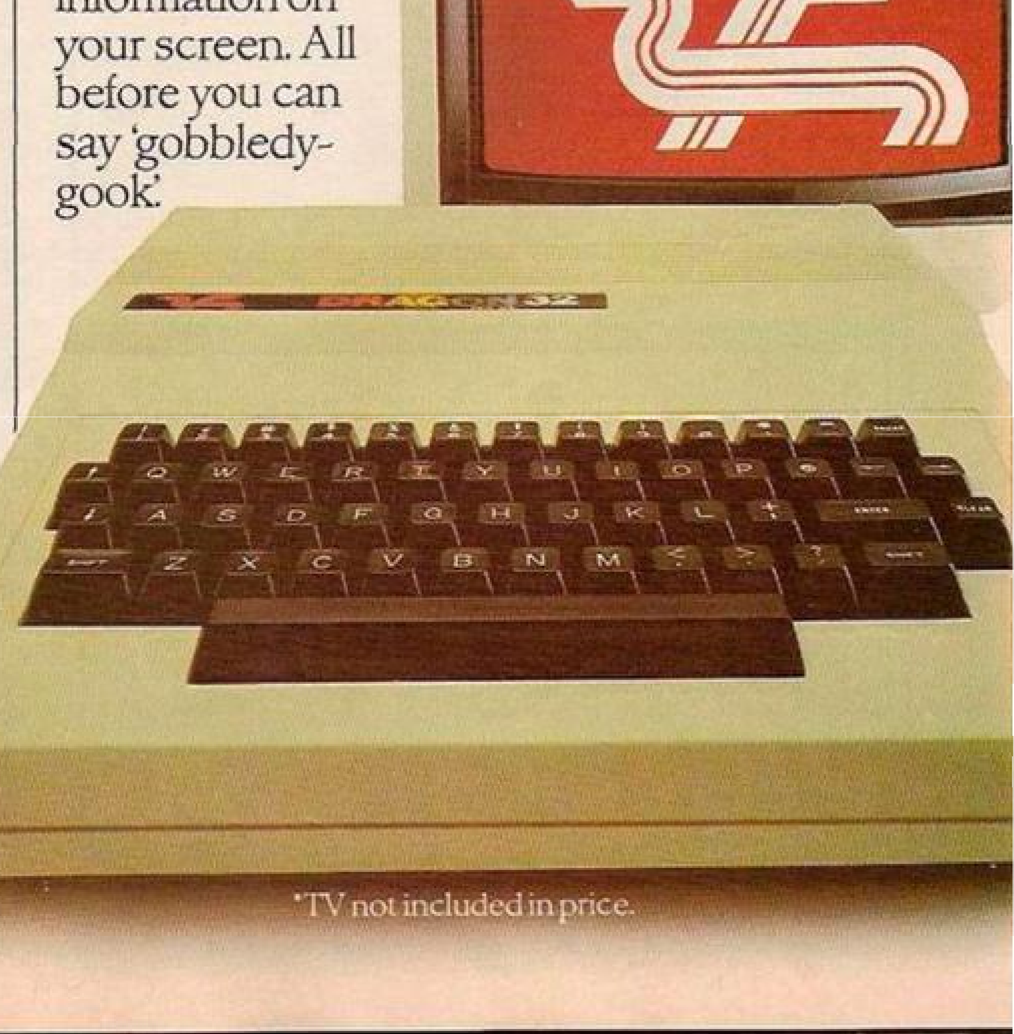
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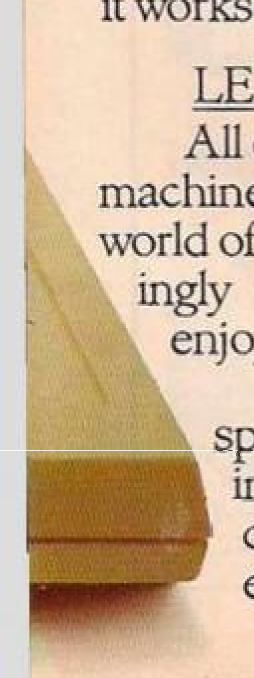
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STANDARD AVAILABLE RAM FOR HIGH RESOLUTION GRAPHICS	26K	9K	N/A	N/A	14K	3K
EXTENDED MICROSOFT BASIC AS STANDARD	YES	NO	NO	NO	NO	NO
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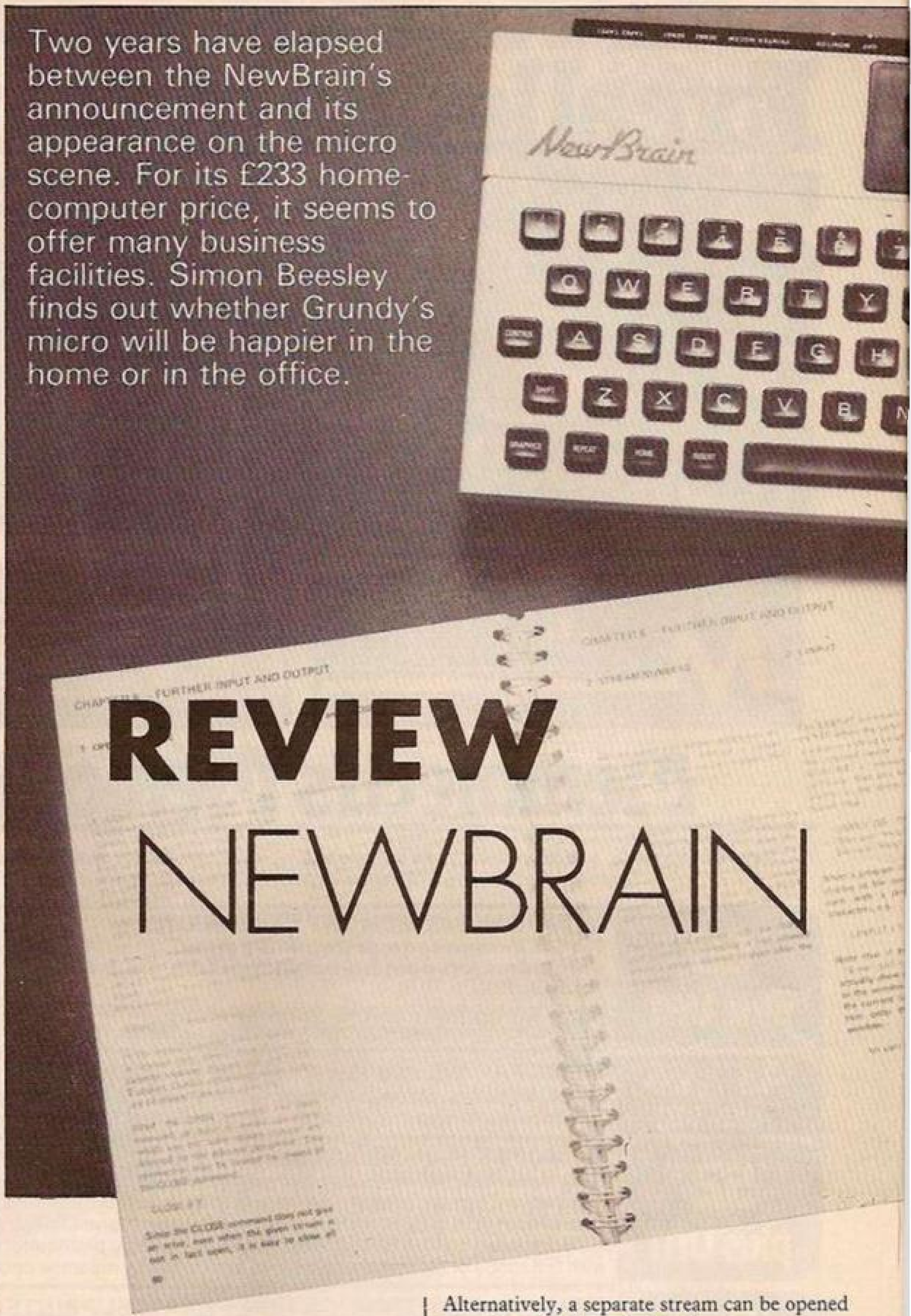
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REVIEW
NEWBRAIN

Two years have elapsed between the NewBrain's announcement and its appearance on the micro scene. For its £233 home-computer price, it seems to offer many business facilities. Simon Beesley finds out whether Grundy's micro will be happier in the home or in the office.



ADVERTISEMENTS for the NewBrain suggest that after using its graphics to impress the board of directors, a businessman can pop the machine into his briefcase and take it home to entertain or instruct the family: Junior can learn a foreign language while mum can . . . You are probably familiar with this rather unconvincing scenario. Despite those claims, it seems clear that the NewBrain has been designed primarily for business applications. Its role as a personal or home computer is only at best a secondary one.

However, since the machine costs little more than a Vic or a Spectrum it is not unfair to consider it in the same light. Could the NewBrain compete with pure and simple personal computers on their own ground?

Expandable memory

Model A costs £233 and Model AD, which has a single-line fluorescent display on board as an extra feature, costs £267.50. The line display is 16 characters wide and can act as a window on the screen or separately. Both models come with 32K RAM and 29K ROM.

An unusual feature, more appropriate to the NewBrain's business role, is its very large memory expandability. Each expansion module supplies up to 512K RAM. Connecting up to a maximum of four models would make 2Mbytes of memory available.

Despite the unit's compact size, the keyboard has almost a full typewriter span and the keys allow fast typing speeds. At the back there are sockets for two cassettes, TV and monitor, ports for a printer, Modem and expansion board but no power switch. This is an irritating omission as it is not difficult to crash the system.

Graphic range, no colour

The NewBrain does not offer colour or sound — probably its major failing as an alternative to other similarly-priced home computers. In compensation, it provides a wider range of text characters and graphic symbols than any other micro at this price. By using the control key you can choose one of four character sets, drawn from a total of 512 characters, including more than 150 graphic symbols and the Greek alphabet. A single-statement entry can change the display from a 40-character by 24-line format to 80 by 30.

Although NewBrain's Basic is compiled and conforms to the ANSI standard, its set of terms and functions is more or less the same as that of the more common Microsoft interpreted Basics. The command Put, for example, has a similar but wider function to the BBC's VDU statement: not only can it send cursor-control codes to determine the display output but it can also send control codes or data to any other device such as the line display or printer.

String handling is supplemented by INSTR, which searches a string for a selected character and returns its position, and a facility for defining string functions. A function FNF$(A$), for instance, could be defined to insert the string A$ in a given sentence.

The screen editor is one of the most effective available and compares very well with its Spectrum or Vic counterparts. You can readily delete any part of a program line in front or after the cursor, insert code and split a line into two, using a combination of the Insert, Repeat, Shift and Cursor keys.

So far, straightforward enough. But if you wish to take full advantage of the machine's capability you will need a certain amount of patience and perseverance. The Open statement allows you to open and define, through a list of parameters, an input or output data "stream" to a particular device such as a TV or monitor, or the printer.

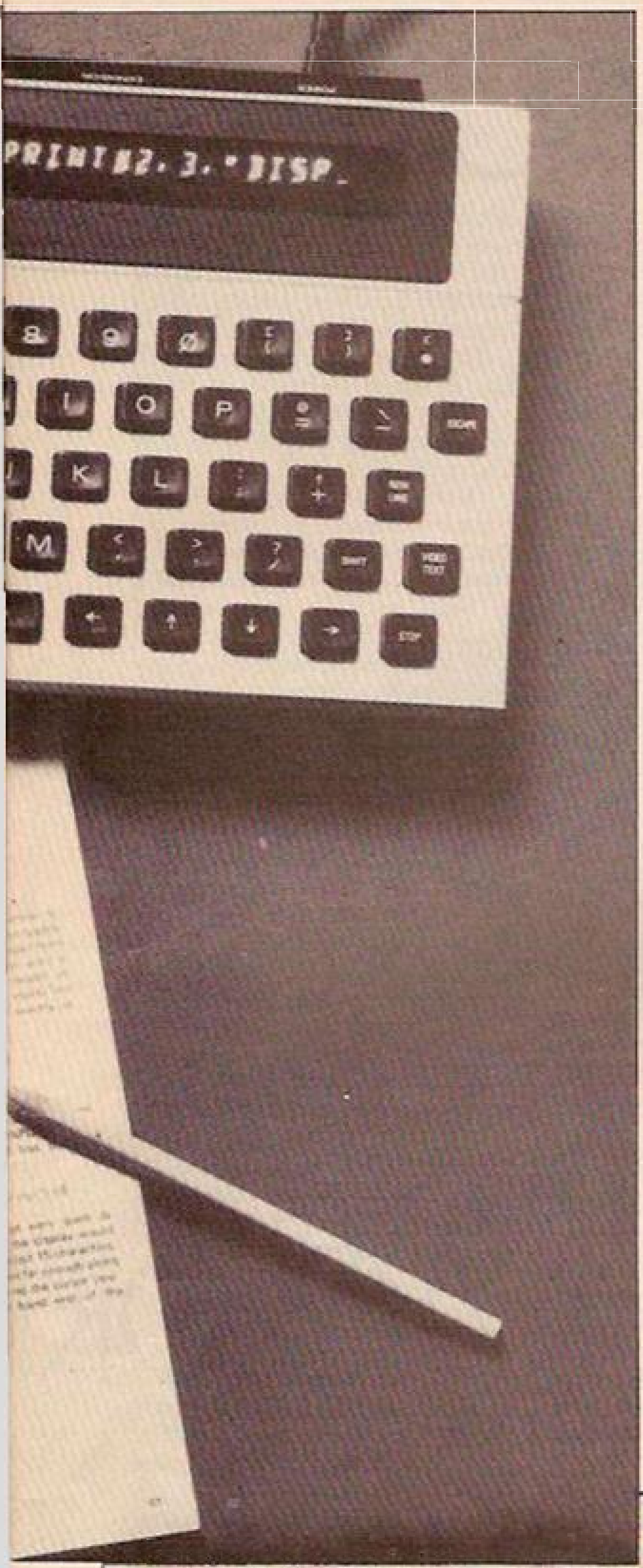
Thus, the console stream which links keyboard and display can be redefined to give the display a width of 80 characters and a depth of 100 lines. Only 24 lines will be visible but by using the cursor keys 100 lines of text can be scrolled up and down the screen window. Alternatively, a separate stream can be opened to write to the line display alone.

In effect this brings a number of input and output routines, which are more commonly submerged in the operating system, under the programmer's control. But given the novelty of this feature, its uses and applications are explained in the manual in too sketchy a fashion.

Not so user-friendly

Far from being "friendly" at times the system appears to be downright hostile, as one of a total of 120 error codes sends the user scurrying to the error appendix. Much of the blame here can be ascribed to poor documentation.

The procedure for obtaining high-resolution graphics is somewhat cumbersome. First you have to open an area memory for a text screen,



which can then be made available for high-resolution graphics by linking a graphics data stream to the text stream. Once you have accomplished this, you will have a relatively powerful graphics capability at your disposal.

Defining the width and depth of the screen, and as a consequence its resolution, gives a choice of 256, 320, 512 or 640 pixels horizontally and up to 250 pixels vertically. The statements Range and Centre permit you to choose the scale of the x and y pixel co-ordinates and position the origin, while Axes draws and marks off the two axes.

The command Fill fills in an area and Arc draws an arc through a given angle. Other commands allow lines to be plotted either relative to the pen position or in terms of the screen co-ordinates; the pen can be moved or rotated without drawing, and mixing graphics and text is possible.

In common with the Atari and the Dragon, the NewBrain does not hold its screen data in a fixed area of memory. This makes it possible to create multiple screen memories in RAM and switch between them. You could set up a screen page 200 lines deep; scroll it up or down the screen window and then jump to any other page of text or high-resolution graphics.

Educational applications

This facility has obvious potential for educational applications, graphic games and animation effects. Naturally enough it consumes a good deal of memory: creating a screen page 40 characters wide by 200 lines deep takes up more than 10K.

None of these techniques is, however, covered in sufficient detail by the manual, which bears all the marks of rushed preparation. The released version of the *NewBrain Handbook* contains an errata slip, listing some 35 errors and it was no surprise to find a small error among the slip's corrections.

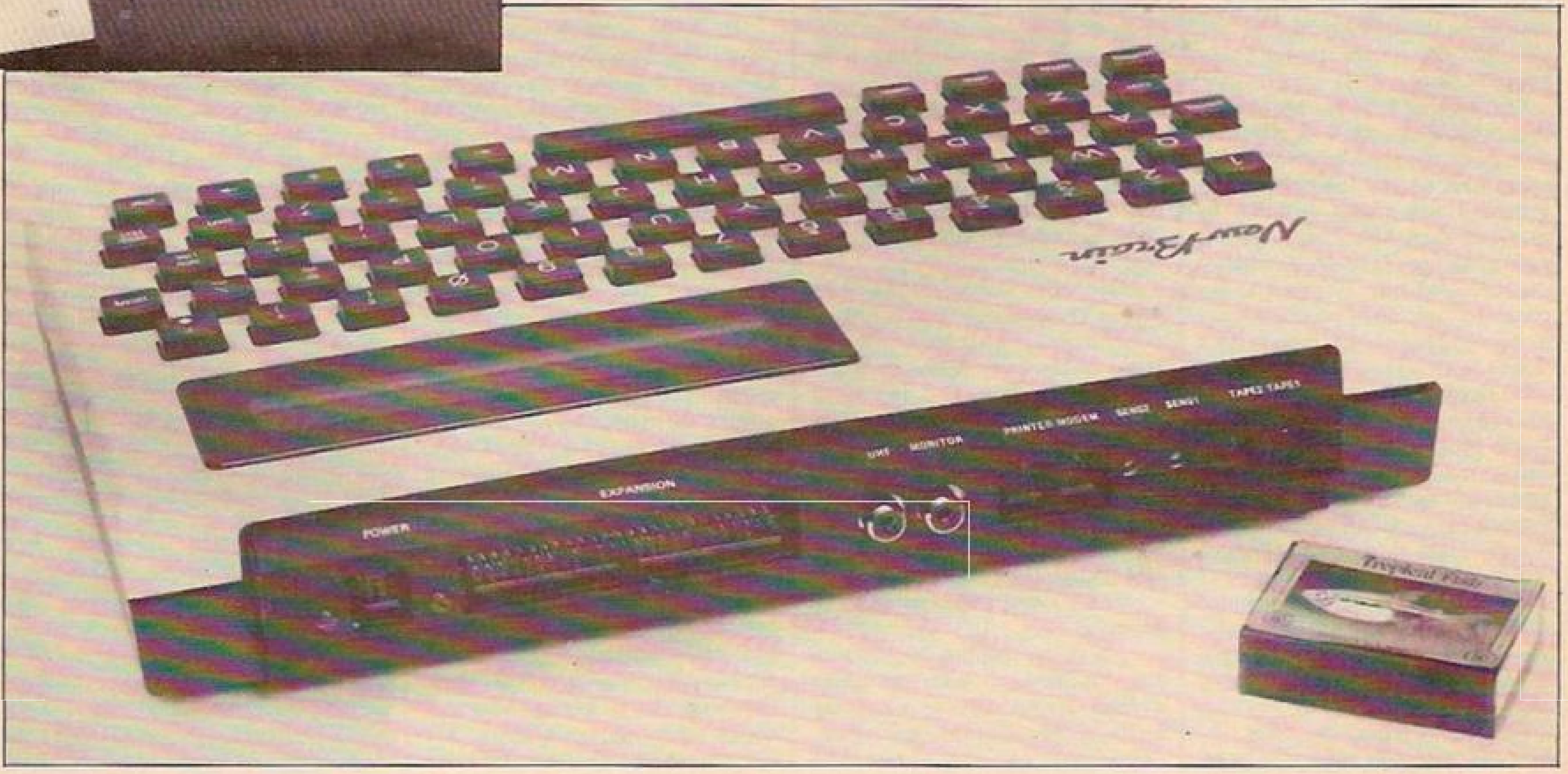
Those commands that will be relatively new to anyone reared on, say, a Sinclair or Commodore micro are only briefly, and sometimes obscurely, explained. The *Software Technical Manual,* seen in a pre-draft version, describes the various operating system modules and does not enlarge on the *Handbook.*

What is needed is something like the *Programmer's Reference Guide* for the Vic-20, which expands on the manual's explanations before gently initiating the user into the higher mysteries of the operating system.

Admittedly, most manuals leave something to be desired and compared with the BBC's manual — still provisional after all these months — the NewBrain's is a model of thoroughness. Perhaps the NewBrain *Beginners' Guide,* promised for the near future, will make life easier for the newcomer.

CONCLUSIONS

- As a business machine, the NewBrain should do well: its highly adaptable operating system and large potential memory makes it suitable for applications which were hitherto only within the scope of machines several times as expensive.
- The low quality of its documentation will not matter here since its memory capacity — 4Mbytes of ROM can be accessed through a ROM Buffer expansion module — should encourage the production of easy-to-run, tailor-made software.
- It will also shortly be possible to attach a communications interface enabling 32 NewBrains to share the same peripherals. This could well earn it a place in the micro education market.
- It is unlikely that these features will appeal to the bulk of personal computer buyers, most of whom will be deterred by the lack of colour and sound.
- On the credit side, no other computer under £300 offers such an extensive character set or such high-resolution graphics.
- It could not be recommended to a beginner but could prove attractive to an experienced user who is prepared to explore some of the possibilities only hinted at in the manual. ■



HERMANN HAUSER:

What made the BBC choose Acorn not Sinclair — and why is Hermann Hauser, Acorn's Technical Director, so sure the Electron will upstage the Spectrum? Meirion Jones hears the inside story.

SIX O'CLOCK ON a bleak December morning and all was far from well. Acorn's design team had been working round the clock since Monday when the man from the BBC had called. Now it was Friday and in a few hours he would be back to see the working prototype he had been promised by the end of the week.

Unless they managed to have the machine working, the BBC might take the project elsewhere. Hermann Hauser had to think quickly. "I said: 'It's very simple — you are cross-linking the clock between the development system and the prototype. If you just cut the link it will work.'"

The tired team was sceptical about "another Hermann suggestion" but they cut the umbilical cord to the machine. "Lo and behold, it worked. It was a great moment — absolutely terrific to see this machine spring into life."

Hermann Hauser's quiet enthusiasm is infectious as I found when I recently witnessed the first successful test of Acorn's new speech synthesiser. As the BBC micro began to give voice "One .. two .. three .." one Acorn engineer was unable to contain himself: "This is much better than we've ever had — it must be the only British English-speaking computer there's ever been."

Predictably, perhaps, the people who brought you the BBC computer are now working on the BBC computer voice. Instead of the Detroit Dalek sound favoured by previous chips Acorn has employed a disembodied Kenneth Kendall to declare "This is an Acorn computer" much as he might have intoned "This is the nine o'clock news".

By October, Acorn will be selling an add-on Kenneth Kendall-speak ROM and speech processor for the BBC machine. The first unit will voice letters, numbers, keyboard symbols and commonly-used commands. Later Acorn will release a more comprehensive allophone package about which the engineer was even more enthusiastic: "Allophone speech will have inflections as well — it will be really amazing."

Hermann Hauser describes the advantages in more measured tones: "You can concatenate allophones to make any utterance in the English language."

An English language course was what first persuaded Hermann Hauser to leave the attractions of his family's wine business in Austria and come to Cambridge. Although he went back to Vienna to take a physics degree, he soon returned to Cambridge to complete a PhD in solid-state physics at the Cavendish laboratory.

Motivated by an urge "to find out what makes the world tick — in its innermost workings" Hauser developed an interest in artificial intelligence.

Some of Acorn's current ventures involve artificial-intelligence techniques, but Hauser's first venture was more mundane. After persuading Chris Curry to leave Science of Cambridge in 1978, the two of them set up first CPU and then Acorn Computers.

"The first thing we did was a consultancy job for a fruit machine manufacturer". Hauser soon found that although it was easy to make the one-arm bandit do what you wanted, it was difficult to prevent it paying up when it should not: "It lives in a very cruel enviroment — people bang it ana throw beer at it and try to fool it." Eventually Hauser had to build in a VHF radio to detect sparks

'Very much an Apple and Pet competitor and beyond'

"so that if anyone walked up to it with a spark gun it would switch the machine off and reset it".

Meanwhile Sinclair was having great success with his Mk14 hobby computer. Once 10,000 had been sold Hauser decided that "the so-called consultancy work we were doing for other people we might as well do for ourselves".

Acorn's first machine, the System 1 was "way above the Mk14 — rather more compact but still aimed at the hobby market. We were in a very exciting field. Everyone knew that whatever the market was going to do, it wasn't going to shrink."

The first sign that micros would become more than hobbyists' toys was when Newbury Laboratories first announced plans for the NewBrain in 1980. Acorn responded within six months by producing the Atom.

Such speed was possible because "at that time the sums needed to develop new machines were not very high and the marketing concept was right thanks to Chris Curry. Also Acorn works effectively as a team".

"During the development of the Atom, schedules were very tight — the whole design team would take a break about 7pm and discuss things over dinner together then go back and work till 10 or 11pm."

At one of these brainstorming sessions the team heatedly discussed what features they would like to see in the Atom's successor — at that time tentatively called the Proton.

"All these prima donnas in the design department had very strong

'Sinclair is comparing chalk and cheese'

ideas of what they wanted. One wanted a double-processor system, another said: 'It can all be done on a single processor'. Andy Hopper said it had to be a 16-bit machine. Chris Curry said: 'Boys, whatever you do don't make it more than £300'."

There seemed to be no way to reconcile all these conflicting demands until the idea of a self-contained but infinitely extendable system was suggested. "The tube solved our problems — everyone could have all they wanted and more. We could start with an inexpensive 6502-based machine and then make a second processor and eventually a 16-bit extension available. We had a good drink after that and got rather self-congratulatory."

Soon afterwards the BBC came along and the race was on to turn the idea of the Proton into a working BBC prototype. Hauser rejects Sinclair's criticism of the BBC deal.

"He seems to have a terrible chip on his shoulder about this because he was not the chosen one. The BBC used us because they came on the Monday with the specifications they wanted and returned on the Friday and saw a working prototype."

"I defy anybody else in this country to build a completely new 32K computer that quickly. "We employed the fastest gun in Cambridge — called Ramany Banerjee — not only is he an excellent designer, he can also wire wrap faster than other people can call out the connections."

Hauser is not afraid of Dragons — or for that matter of Spectrums or any other new micros: "None of them is expandable in the same way as the BBC — that market will be adequately dealt with by the Electron".

"The BBC is very much an Apple and Pet competitor — and in fact beyond that because of the 16-bit extension. It is a very advanced design and we do not see any computers with these features appearing for another year or so. A very useful extension offering Z-80 and CP/M will be available in the autumn and the 16032, 16-bit extension by the end of the year".

The 16032 is really exciting — you can go up to megabytes of RAM, you can run the Unix operating system and big languages such as Fortran, Cobol and PL-1."

"Sinclair is the only one who has enough arrogance to compare the BBC computer with his own. He is comparing chalk with cheese and it is based on his own exceptional arrogance rather than the facts.

"We thought the appropriate way of dealing with this was to produce a machine which shows him how it is really done. "You get these quantum leaps in electronics — we will leap-frog Clive Sinclair with technology. The Electron will have twice as much ROM, twice as much RAM and an uncommitted logic array (ULA) three times as big as the Spectrum's.

Hauser attributes Clive Sinclair's prominence to his public relations: "He has a remarkable machinery for dealing with the press — second to none in our field. It is quite remarkable the way he fights with this weapon. Despite his claims, his machine is not very complex — whereas ours exploits RAM, ROM and ULA techology to the full. We

ACOR

do not know of any other company that is capable of doing it. The Electron is right at the cutting edge of technology."

One of the penalties of being on the cutting edge of technology seems to be production difficulties. When the subject of Acorn enthusiasts who have grown old waiting for their BBC micros is raised, Hauser smiles: "We've learnt our lesson." The only lesson learnt by the tens of thousands still waiting for Spectrums and BBC model Bs might be never to trust the word of a micro company — so how does Hermann Hauser



INTERVIEW



N IN A NUTSHELL

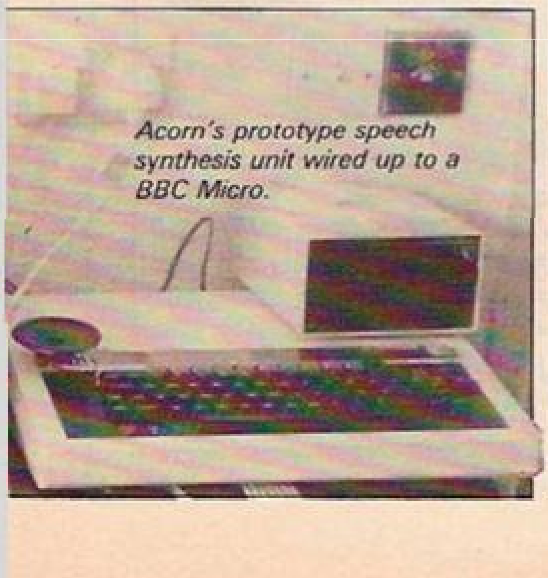
explain the late-delivery problem?

"It is always very difficult to predict the exact numbers people will order, and you can only predict to within a factor of two or three — if you estimate too low you have serious delivery problems — if too high you can go bust because you've ordered too many components.

"We are the only company in this field which designs its own ULAs. This allowed us to produce a computer as versatile as the BBC because we were able to milk the Ferranti processor — but it also meant that we had difficulties in high-volume production because the yield was too low. There were limitations of the Ferranti processor that neither we nor they knew about.

How does Acorn intend avoiding these problems with the Electron? "We are now of a size which allows us to pick our subcontractors with care — if they say something will arrive in June you can bet it will.

"The chip that we are doing for the Electron is a very much more cautious approach to ULA design — there won't be any problems with the ULA."



Acorn's prototype speech synthesis unit wired up to a BBC Micro.

Acorn has been accused of profiteering from the delays by raising BBC prices. Hauser answers: "If you look at the specification of this machine it is still too cheap." As for the backlog for model Bs: "I know we have made promises before but we are now in really high-volume production."

Hauser praises Sinclair for trying to develop new storage devices. "The Microdrive heralds a new generation of microfloppies," but then he qualifies this: "Although once again Sinclair is cultivating much better public relations than the other companies, I think he has got it wrong — it is unwise at the moment to go for a non-standard drive."

Hauser expects the Microdrive to become obsolete quickly because of a lack of real random access. "There will be a standard 3.5in. or 3in. drive which will be produced in world-wide quantities, and will be not only be less expensive but will also provide the facilities the Microdrive lacks." Hauser expects Acorn to be selling its own version of this drive by next Easter.

'The Electron is right at the cutting edge of technology'

One of the fruits of Acorn's collaboration with the BBC was the language for the BBC Micro. Hermann Hauser hopes that BBC Basic will become as much of a standard as BBC English.

"No other Basic in our field supports structures which is important if you want to teach good programming. It is very advantageous to split the program into blocks and debug them individually so you can say: 'Now I know this works I can go on to the next one'."

Nor is this the only advantage Hauser claims: "Our Basic runs between four and 10 times faster than anybody else's — in particular Sinclair's. As a result you can write programs in Basic which other people have to write in machine code."

Hauser does not believe that Sinclair's Basic has become the standard by virtue of sheer numbers: "There are more people using ZX-81 Basic — but the question really is does one want to standardise on the lowest common denominator. It would be wrong to home in on a standard which leaves out essential elements in the language."

Another spin-off from the BBC deal was Acorn's involvement in setting a telesoftware format which may become the U.K. standard.

Acorn seems determined to maintain a broad range of skills: "We've hardware expertise, software expertise, local-area networks, chip design, all in-house." The company plans to launch a phenomenal number of products over the next few months. In addition to the BBC speech chip and of course the Electron, the company will be launching AcornCalc, a financial planning package, and a networking system for the BBC.

Hauser loves Cambridge but the reasons for Acorn being based there are rather more hard-headed: "The same reason that made Highway 128 in Boston and Silicon Valley what they are — spin-offs from the university — access to good graduates and computer lab facilities. If I do have a problem I can just pick up the telephone."

Microcomputer companies are notorious for not making use of their own technology. But even though there is no sign of a computer in Hauser's office he insists: "We do want to be different there". Plans are in hand to install a network inside Acorn.

Eventually Hauser would like to connect up his BBC at home to the office network. In the meantime: "I use it for games at home like everyone else — I try out new Acorn software — and sometimes find bugs in it that the other boys have missed. Being a physicist I use it for calculations or for working out company problems."

Hauser's continued interest in physics is evidenced by the choice of elementary particles as names for Acorn's computers: Atom, Proton, Electron. At the height of the delays some wit even suggested that the BBC/Proton should have been called the Quark because people had been waiting so long to see one.

So how long will we have to wait for the launch of the Electron? "The other lesson we learnt from the BBC machine is not to announce a product until you are sure you can deliver it — that's why I'm cautious and say it will be out by the end of the year." ■

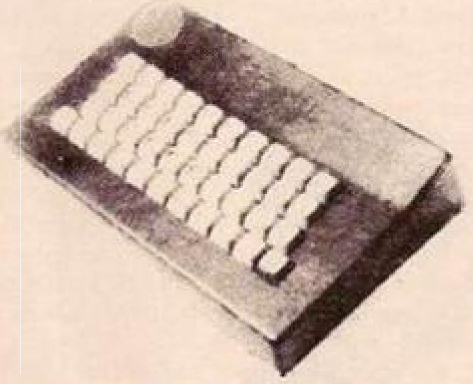
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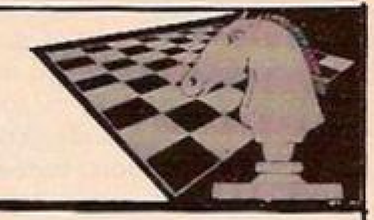
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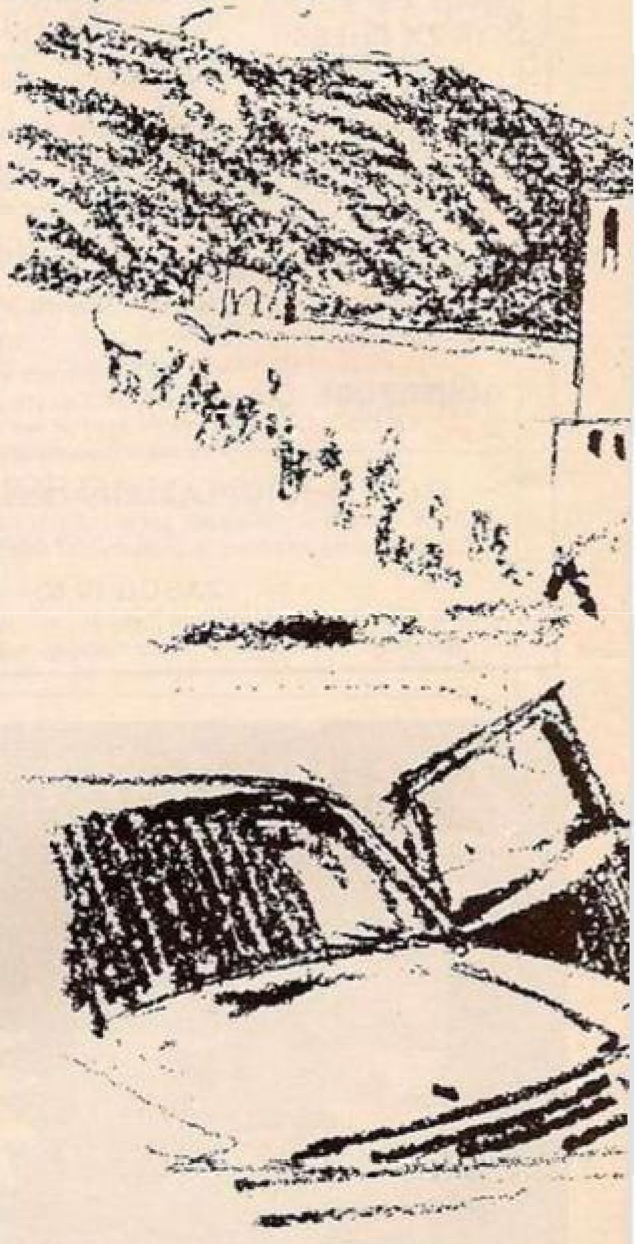
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GAMES

VIC DA

Can you stop the Nibblers destroying the dam? Dave Shambrook's game is for the unexpanded Vic-20.



THE DAM AT the head of the valley is under attack from an unidentified source. If the dam bursts, the water will escape and flood the valley, killing thousands. Your mission is to destroy the aggressors, code-named Nibblers, and save the dam.

The Nibbler appears on the right-hand side of the screen and moves across towards the dam on the left. To stop the Nibbler and launch your ship at the same time, you hit the space bar. When you are directly above the Nibbler, press the space bar again to drop your bomb.

If you hit the Nibbler, your score increases by one point and the dam has been saved for a little longer. But if you miss, you forfeit a point and the Nibbler lives on to destroy part of the dam. Another Nibbler will then appear on the right-hand side of the screen.

Once the dam has been totally breached, the water will escape and flood the valley, and you have failed in your mission. You are then told your score and time taken, and asked if you want to try again. Type "Y" for another game and "N" if you wish to stop — nothing else will be accepted.

If the computer has been expanded and so has extra memory you could use the user-definable graphics capability of the Vic to improve the game. If so, the following routine should be added at the end of the program, and line 3 changed to:

```
3 PRINT CHR$(14): GOSUB 1000
1000 FOR I = 0 TO 1024
1010 POKE 5120 + I, PEEK (32768 + I): NEXT I
1020 FOR I = 0 TO 1024 : READ A
1030 IF A = 1 THEN 1070
1040 POKE 6144 + I, A : NEXT
1050 DATA 56, 124, 230, 3, 3, 230, 124, 56
1060 DATA 24, 60, 102, 231, 166, 24, 36, 68
1070 POKE 36869, 253 : POKE 36866, PEEK
     (36866) OR 128
1080 RETURN
```

If this program is used, the Pokes and Peeks will have to be changed — 60 to 128 and 62 to 129.

The main variables used in the program are:

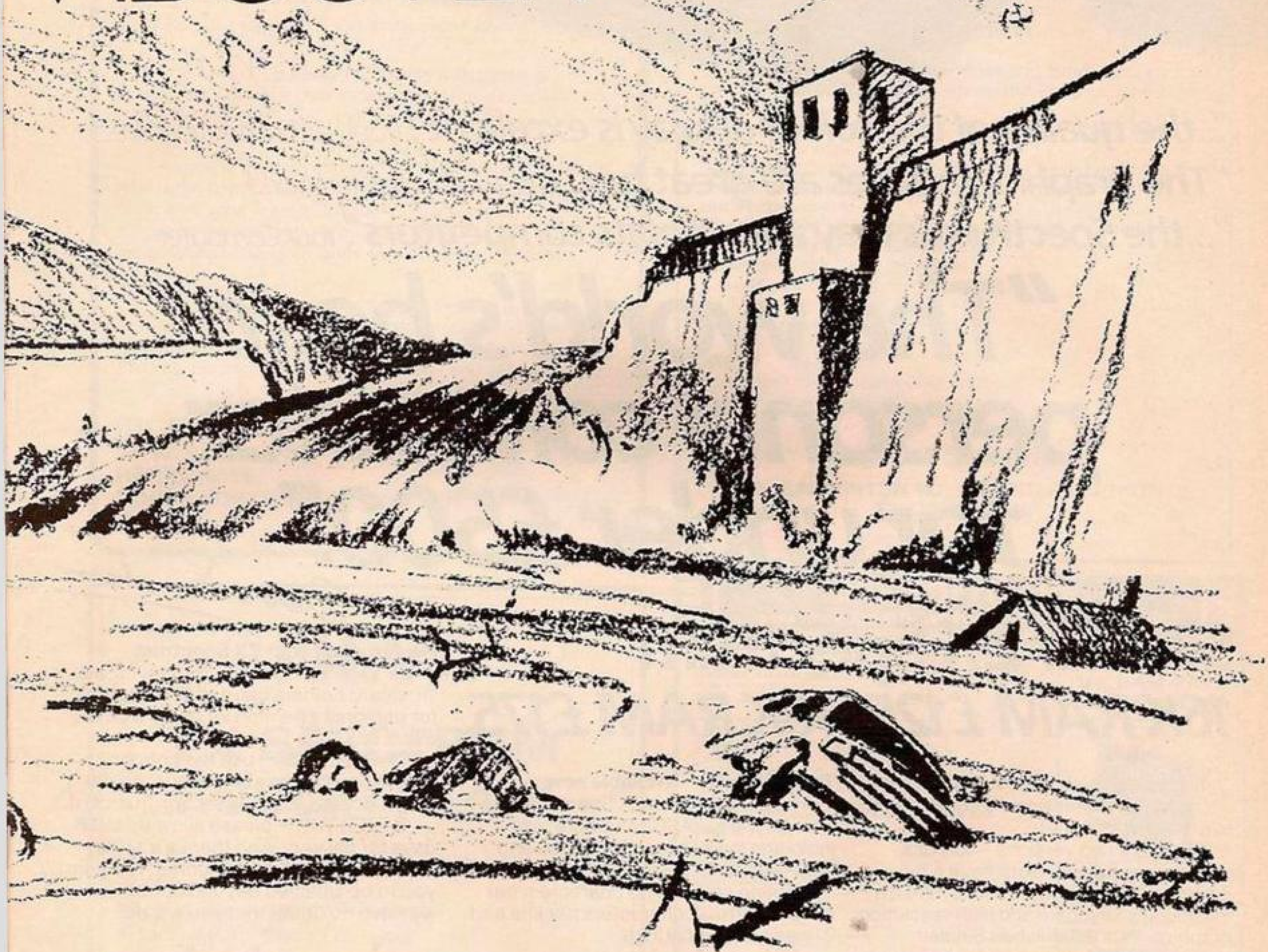
B — position of ship
C — position of bomb
D — position of Nibbler
O — highest score
S — score

The other variables are used mainly in For — Next loops etc. Here is a more detailed explanation of the program:

3:	switches to text mode.
4 to 68:	print the title page. The graphic symbols are obtained by pressing shift and each of the following: N I B B L E R S.
65:	note that there are eight spaces after the cursor symbols.
70 to 150:	print out the instructions for the game.
70:	the graphics symbol is shift and "T".
80:	the graphics symbol is shift and "N".
110:	the graphics symbol is shift and "T".
120:	the graphics symbols are shift, together with "S" and then "N".
130:	the graphics symbol is shift and "I".
140:	the graphics symbol is shift and "H".
159 to 260:	construct the dam and fill the reservoir with water.
261 to 262:	print the score and resets the timer.
270 to 280:	set up the random position of the Nibbler.
290 to 294:	check to see if the Nibbler is hitting the dam or the water.
295:	turns on the sound register and vibrates screen from left to right.
450:	if the space bar is pressed then the bomb drops, else continue moving Nibbler.
491 to 500:	plot the falling bomb.
505 to 512:	checks to see if bomb has hit the Nibbler or the ground. If not, then continue to plot the bomb.
552 to 554:	explosion sound effect.
565 to 568:	vibrate screen up and down.
578:	restores screen to normal position.
590 to 616:	plot the water pouring out of the dam.
620 to 646:	print your score and the time that you lasted for.
620:	graphics symbol is shift and "T".
645:	graphics symbol is shift and "Y".
650:	graphics symbol is shift and "A". Type "Y" for another go, or "N" if you wish to stop.
710:	switches the computer back into graphics mode.

```
0 REM    NIBBLERS              BY D.SHAMBROOK
1 REMCONCHAT
2 PRINT"▒":O=-32
3 PRINTCHR$(14)
4 POKE36879,237:POKE36878,15
5 FORM=7680TO7701:POKEM,224:NEXT
6 FORM=7702TO8164STEP22:POKEM,224:POKEM+21,224:NEXT
7 FORM=8164TO8185:POKEM,224:NEXT
8 FORB=1TO5
9 POKE36875,200:POKE36876,0
10 FORL=1TO500:NEXT
15 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒";:FORP=1TO200:NEXT
20 PRINT"╲";:FORP=1TO200:NEXT
25 PRINT"|";:FORP=1TO200:NEXT
27 PRINT"|";:FORP=1TO200:NEXT
30 PRINT"L";:POKE36876,200:POKE36875,0:FORP=1TO200:NEXT
35 PRINT"‾";:FORP=1TO200:NEXT
40 PRINT"_";:FORP=1TO200:NEXT
50 PRINT"•";:FORP=1TO200:NEXT
65 PRINT"▒▒▒▒▒▒▒▒        ";:FORP=1TO200:NEXT
68 NEXT
69 POKE36879,25:POKE36876,0
70 PRINT"▒HE OBJECT OF THE GAME"
80 PRINT"IS TO HIT THE /IBBLERS"
90 PRINT"BEFORE THEY DESTROY":PRINT
100 PRINT"THE DAM.":PRINT
110 PRINT"   |HE CONTROLS ARE:":PRINT
120 PRINT"♥PACE TO STOP /IBBLER":PRINT:PRINT"AND LAUNCH YOUR SHIP,":PRINT
130 PRINT"AND SPACE AGAIN TO":PRINT:PRINT"DROP YOUR BOMB.╲F YOU "
131 PRINT"MISS YOU LOSE A POINT.":PRINT
140 PRINT"▒IT A KEY TO CONTINUE"
150 GETA$:IFA$=""THEN150
151 POKE36879,191
155 PRINT"▒"
156 FORM=8164TO8185:POKEM,224:POKEM+30720,5:NEXT
159 REM****************        *CONSTRUCT DAM*        ****************
165 V=12:POKE36878,15
170 A=0
180 FORB=7724TO8164STEP22
185 POKE36877,220:FORX=1TO5:NEXT:POKE36877,0
190 POKEA+B,224:POKEA+B+30720,6
200 NEXTB
210 A=A+1:IFA<2THEN180
220 FORA=0TO1
230 FORB=7726TO8167STEP22
235 POKE36877,220:FORX=1TO5:NEXT:POKE36877,0
240 POKEA+B,102:POKEA+B+30720,0
250 NEXTB
260 NEXTA
261 PRINT"▒SCORE";S
262 TI$="000000"
263 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒HIGH"O
264 REM****************        ****NIBBLER****        ****************
270 A=INT(RND(1)*19)+1:D=7744:B$="":F=0
280 FORP=1TOA:D=D+22:NEXT
290 IF PEEK(D)<>102THENF=0:GOTO380
294 IFPEEK(D-1)=224THEN500
295 POKE36878,15:POKE36864,11:POKE36877,250:FORM=1TO40:NEXT:POKE36877,0:POKED,3
2
300 POKE36864,12:GOTO270
380 POKED,60:POKED+30720,0
385 IFB$=" "THEN400
390 GETB$:IFB$=" "THEN430
400 D=D-1
```

MBUSTER



```
405 POKE36878.15:POKE36876.140:FORW=1TO20:NEXT:POKE36876.0
410 FORM=1TO20:NEXT
420 POKED+1.32:GOTO290
424 REM*****************        ****SHIP*******       ***************
430 FORB=7702TO7723
440 POKEB.62:POKEB+30720.0
445 POKE36878.15:POKE36876.220:FORP=1TO5:NEXTP:POKE36876.0
450 GETC$:IFC$=" "THEN490
470 FORP=1TO20:NEXTP
480 POKEB.32:NEXTB
481 GOTO300
484 REM*****************        ****BOMB*******       ***************
490 L=200
491 FORC=B+22TOB+484STEP22
495 IFB<7708THEN500
496 POKE36878.5:L=L-1:POKE36876.L
500 POKEC.46:POKEC+30720.0
505 IFPEEK(C+22)=60THENS=S+1:GOTO550
510 R=0
512 IFPEEK(C+44)=224THENPOKE36876.0:POKEC.32:R=1:S=S-1:GOTO550
520 FORP=1TO30:NEXT:POKEC.32
530 NEXT
540 POKEB.32:GOTO300
550 POKE36876.0:POKEC+22.32:POKEC.32
551 PRINT"■SCORE"S
552 POKE36877.220
553 FORW=15TO0STEP-1
554 POKE36878.W
565 IFR=1THENPOKE36865.37
566 FORE=1TO30:NEXTE:IFR=1THENPOKE36865.39
567 FORE=1TO30:NEXTE.W
568 POKE36877.0:IFR=1THENPOKE36865.38
569 FORM=8TO7723
570 POKEM.62:POKEM+30720.0:POKE36878.15:POKE36876.220:FORW=1TO5:NEXT:POKE36876.
0
571 FORM=1TO40:NEXT:POKEM.32
575 NEXT
578 IFR=1THENPOKE36865.38:GOTO290
580 GOTO270
590 FORZ=0TO1:POKED+Z.224:POKED+Z+30720.6:NEXT:PRINTCHR$(142):POKED+2.223:POKED
30722.6
594 POKE36878.4:POKE36877.180
595 FORZ=D+24TOD169STEP22:POKEZ.224:POKEZ+30720.6:NEXT
599 FORZ=D185TODSTEP-1
600 POKEZ.224:POKEZ+30720.6
610 NEXT
620 PRINTCHR$(14);"■■■■■■■THE DAM HAS BEEN":PRINT
630 PRINT"DESTROYED AND ITS ALL":PRINT
640 PRINT"■■■■YOUR FAULT!!!":PRINT
644 U=INT((TI+0.5)/60)
645 PRINT"■■YOU LASTED"U"■ SECS":PRINT
646 PRINT"■■■■AND SCORED"S:PRINT:PRINT
647 IFS<0THENS=S
650 PRINT"■■ANOTHER GO(Y/N)?":PRINT"■"
655 POKE36877.0
660 GETD$
670 IFD$="Y"THENPRINT"■":S=0:GOTO70
680 IFD$<>"N"THEN660
700 PRINT"■"
710 PRINTCHR$(142):POKE650.0
720 END
```

■



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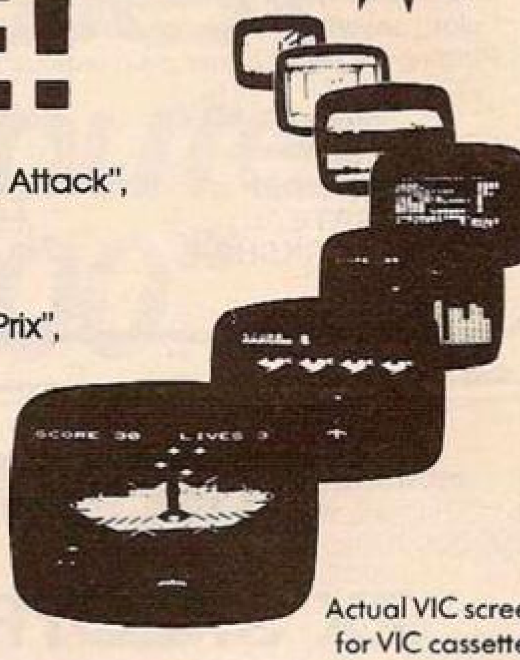
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INTELLIGENT TYPEWRITER

ATOM

Dave Berry's machine-code program for the Atom transforms your Acorn into an intelligent typewriter with many of the features of a word processor.



MOST REGULAR users of typewriters and word processors have probably long felt the need for a facility somewhere between the two. It would be useful to be able to edit each line of text before it is printed, since most typing errors are noticed immediately after they are made. Justifying the right margin for neatness, but without the overheads involved in true word processing would be another boon.

Word processors are ideal for reports and such like but for the simple letter, the extra work involved in setting up files and storing text before it can be printed is a distinct nuisance.

"T" fills this gap between typewriters and word processors. Written entirely in 6502 machine-code for the Acorn Atom it is both fast and compact, filling just 767 bytes of precious RAM. Nevertheless, it is able to support all the following functions:

- Edit before print.
- Right-margin justification.
- Adjustable line spacing.
- Key-blip routine.

The listing shows the Basic and assembler source-code version of "T". This listing has

(continued on next page)

(continued from previous page)

been produced with a reform programme called ABC which, among other things, produces lines of up to 254 characters. Thus when you are entering "T" you will find it necessary to break up some of the lines into two or three shorter ones. I have also included a straight hexdump of the object code and you may prefer to enter the programme in that way.

The assembler program must go into memory above # 2AFF to miss the object code. Once entered it can be Run and the resulting code occupies lower text are RAM from # 2800 to # 2AFF. The object code can then be saved with the statement

*SAVE"T"2800 2B00 2800

and can subsequently be used by simply entering

*RUN"T"

Programme line 20 sets up the following initial parameters: line length, 70 characters; bell position, 10 from the line end; left margin, five spaces; and the default line spacing where one gap equals double. These parameters are set by the first four LDR/STA pairs, and any or all can be changed to suit your own requirements, either by altering the assembly listing or by Poking the relevant values into the object code.

Each time "T" is run brief instructions are displayed on the screen to remind the user of the key sequences to use. These are:

CTRL and] together . . .

Justify and print. The routine will not allow justification if it is not possible in one pass over the line.

CTRL and 1, 2 or 3 together . . .

Change the line spacing. This key combination can be entered at any position in the line and is effective immediately.

DELETE . . .

Delete the last character entered — the normal Atom delete.

ESC . . .

Terminate the run and return to the Basic interpreter. "T" can subsequently be restarted by Link # 2800.

RETURN . . .

The normal, unjustified Print command.

The screen display is a series of exclamation marks spaced at every fifth character position, which helps with tabulation, and a line terminator,]. It is essential to note that the line you enter will be printed automatically if the terminator is reached.

To generate capitals, the Shift, or Lock, key must be depressed. Capitals are displayed on the screen as inverse characters, which is the opposite of normal Atom printer practice.

Each time a key is pressed a blip is generated through the Atom's loudspeaker, providing a form of audio feedback for the typist. The tone of the blip rises a set number of characters from the end of the line — the bell position — as a warning.

All the normal Print control codes can be used with care, such as CTRL N for large print and CTRL 4 for overprinting. Since control codes occupy a character position in the buffer, they are indicated on the screen by a grey graphics figure inserted into the line of text displayed. ■

```
>LIST
   10F.A=#2800 TO#2AFF;?A=#00;N.;DIMLL(27);F.A=0 TO27;LL(A)=-1;N.;F.A=0 TO1;P=#2
800
   20[;:LL0LDA@70;STA#82;LDA@10;STA#83;LDA@5;STA#81;LDA@#01;STA#86;LDA@#02;JSR#F
FF4;LDX@#50;LDA@#20
   30:LL22JSR#FFF4;DEX;BNELL22;LDA@#0D;JSR#FFF4;LDA@#03;JSR#FFF4;JSRLL21;LDA@#02
;JSR#FFF4;LDY#82;LDA@#00
   40:LL23STA#2AAF,Y;DEY;BNELL23
   50:LL15LDX@#C0;STX#84;INC#208;INC#208;INC#208;JSR#FD69;LDY#82;LDA@#1D;STA#800
0,Y;LDY@#00;STY#85;LDA@#21
   60:LL9PHA;TYA;CLC;ADC@#05;CMP#82;BPLLL8;TAY;PLA;STA#8000,Y;JMPLL9
   70:LL8LDY#82
   80:LL20JSR#FFE6;PHA;TYA;PHA;LDA@#65;TAY
   90:LL18STA#B003;LDX#84
  100:LL17DEX;BNELL17;EOR@#01;INY;BPLLL18;PLA;TAY;PLA;PHA;SEC;SBC@#11;BMILL25;SE
C;SBC@#03;BPLLL25;PLA;SEC;SBC@#11;STA#86;JMPLL20
  110:LL25PLA;CMP@#1B;BNELL1;DEC#208;DEC#208;DEC#208;LDA@#03;JSR#FFF4;LDA@#0D;JS
R#FFF4;RTS
  120:LL1CMP@#7F;BNELL4;INY;LDA@#00;STA#2AAF,Y;JMPLL2
  130:LL4CMP@#20;BNELL19;INC#85
  140:LL19CMP@#0D;BNELL5;LDA@#00;LDY@#01
  150:LL5PHA;SEC;SBC@#40;BMILL7;PLA;EOR@#20;PHA
  160:LL7PLA;CMP@#1D;BNELL14;CPY#85;BPLLL20;STY#80;INY
  170:LL13LDA#2AAF,Y;PHA;TYA;SEC;SBC#80;TAY;PLA;STA#2AAF,Y;CMP@#20;BNELL12;INY;S
TA#2AAF,Y;DEC#80;BNELL12;LDY@#00;JMPLL11
  180:LL2JMPLL20
  190:LL12INY;TYA;CLC;ADC#80;TAY;JMPLL13
  200:LL14PHA;SEC;SBC@#20;BPLLL27;LDA@#AD;JSR#FFF4
  210:LL27PLA;STA#2AAF,Y;CPY#83;BNELL16;LDX@#80;STX#84
  220:LL16DEY;BNELL2
  230:LL11DEC#208;DEC#208;DEC#208;LDA@21;JSR#FFF4;LDX#86;BEQLL26;LDA@#0D
  240:LL24JSR#FFF4;DEX;BNELL24
  250:LL26LDY#82;LDX#81;LDA@#20
  260:LL10JSR#FFF4;DEX;BNELL10
  270:LL3LDA#2AAF,Y;JSR#FFF4;DEY;BNELL3;LDA@#0D;JSR#FFF4;LDY#82;LDA@#00
  280:LL6STA#2AAF,Y;DEY;BNELL6;LDA@#06;JSR#FFF4;JMPLL15
  290:LL21JSR#F7D1;]
  300?P=#0C;P=P+1;$P="ATOM IS NOW CONFIGURED AS AN";P=P+L.(P)+1;?P=#A;P=P+1;$P="
INTELLIGENT TYPEWRITER";P=P+L.(P)+1;?P=#A;P?1=#A;P=P+2;$P="   KEY          EFFECT
";P=P+L.(P)+1;?P=#A;P?1=#A;P=P+2;$P=" RETURN.   NORMAL LINE PRINTING";P=P+L.(P)+
1;?P=#A;P=P+1
  310$P=" CTRL + ]  JUSTIFY AND PRINT"
  320P=P+L.(P)+1;?P=#A;P=P+1;$P=" DELETE.   ERASE CHARACTER"
  330P=P+L.(P)+1;?P=#A;P=P+1;$P=" ESC.      TERMINATE PROGRAMME";P=P+L.(P)+1;?P=
#A;P=P+1;$P=" CTRL + N  CHANGE LINE SPACING";P=P+L.(P)+1;?P=#A;P=P+1;$P="
   (WHERE N=1,2 OR 3)";P=P+L.(P)+1;?P=#A;P?1=#A;P=P+2;$P="POSITION PAPER, PRESS
 A KEY"
  340P=P+L.(P)+1
  350[;NOP;JSR#FFE6;RTS;]
  360P.''''''''"**********************************"'"P="&P'''''''';N.;LI.LL0;E.

    >RUN
    START?#2800
    END?#2B00

    2800  A9 46 85 82 A9  A 85 83 A9  5 85 81 A9  1 85 86
    2810  A9  2 20 F4 FF A2 50 A9 20 20 F4 FF CA D0 FA A9
    2820   D 20 F4 FF A9  3 20 F4 FF 20 6C 29 A9  2 20 F4
    2830  FF A4 82 A9  0 99 AF 2A 88 D0 FA A2 C0 86 84 EE
    2840   8  2 EE  8  2 EE  8  2 20 69 FD A4 82 A9 1D 99
    2850   0 80 A0  0 84 85 A9 21 48 98 18 69  5 C5 82 10
    2860   6 A8 68 99  0 80 4C 58 28 A4 82 20 E6 FF 48 98
    2870  48 A9 65 A8 8D  3 B0 A6 84 CA D0 FD 49  1 C8 10
    2880  F3 68 A8 68 48 38 E9 11 30  E 38 E9  3 10  9 68
    2890  38 E9 11 85 86 4C 6B 28 68 C9 1B D0 14 CE  8  2
    28A0  CE  8  2 CE  8  2 A9  3 20 F4 FF A9  D 20 F4 FF
    28B0  60 C9 7F D0  9 C8 A9  0 99 AF 2A 4C  0 29 C9 20
    28C0  D0  2 E6 85 C9  D D0  4 A9  0 A0  1 48 38 E9 40
    28D0  30  4 68 49 20 48 68 C9 1D D0 31 C4 85 10 8C 84
    28E0  80 C8 B9 AF 2A 48 98 38 E5 80 A8 68 99 AF 2A C9
    28F0  20 D0 10 C8 99 AF 2A C6 80 D0  8 A0  0 4C 26 29
    2900  4C 6B 28 C8 98 18 65 80 A8 4C E2 28 48 38 E9 20
    2910  10  5 A9 AD 20 F4 FF 68 99 AF 2A C4 83 D0  4 A2
    2920  80 86 84 88 D0 DA CE  8  2 CE  8  2 CE  8  2 A9
    2930  15 20 F4 FF A6 86 F0  8 A9  D 20 F4 FF CA D0 FA
    2940  A4 82 A6 81 A9 20 20 F4 FF CA D0 FA B9 AF 2A 20
    2950  F4 FF 88 D0 F7 A9  D 20 F4 FF A4 82 A9  0 99 AF
    2960  2A 88 D0 FA A9  6 20 F4 FF 4C 38 28 20 D1 F7  C
    2970  41 54 4F 4D 20 49 53 20 4E 4F 57 20 43 4F 4E 46
    2980  49 47 55 52 45 44 20 41 53 20 41 4E  D  A 49 4E
    2990  54 45 4C 4C 49 47 45 4E 54 20 54 59 50 45 57 52
    29A0  49 54 45 52  D  A  A 20 20 20 4B 45 59 20 20 20
    29B0  20 20 20 20 20 20 45 46 46 45 43 54  D  A  A 20
    29C0  52 45 54 55 52 4E 2E 20 20 20 4E 4F 52 4D 41 4C
    29D0  20 4C 49 4E 45 20 50 52 49 4E 54 49 4E 47  D  A
    29E0  20 43 54 52 4C 20 2B 20 5D 20 20 4A 55 53 54 49
    29F0  46 59 20 41 4E 44 20 50 52 49 4E 54  D  A 20 44
    2A00  45 4C 45 54 45 2E 20 20 20 45 52 41 53 45 20 43
    2A10  48 41 52 41 43 54 45 52  D  A 20 45 53 43 2E 20
    2A20  20 20 20 20 20 54 45 52 4D 49 4E 41 54 45 20 50
    2A30  52 4F 47 52 41 4D 4D 45  D  A 20 43 54 52 4C 20
    2A40  2B 20 4E 20 20 43 48 41 4E 47 45 20 4C 49 4E 45
    2A50  20 53 50 41 43 49 4E 47  D  A 20 20 20 20 20 20
    2A60  20 20 20 20 20 28 57 48 45 52 45 20 4E 3D 31 2C
    2A70  32 20 4F 52 20 33 29  D  A  A 70 4F 53 49 54 49
    2A80  4F 4E 20 50 41 50 45 52 2C 20 50 52 45 53 53 20
    2A90  41 20 4B 45 59  D EA 20 E6 FF 60  0  0  0  0  0
    2AA0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
    2AB0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
    2AC0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
    2AD0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
    2AE0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
    2AF0   0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

If you want to live to fly another mission, you will have to use your B-52's high-explosive bomb-load to save you. S A Nicholls puts you in the bomb-aimer's seat with his machine-code ZX-81 program.

YOU ARE AT the controls of a B-52 bomber which is rapidly losing altitude. Your only hope of a safe landing is to level the ground beneath you by shooting away the towers which block your path. Survival depends on clearing a safe landing strip for your bomber.

The game is in machine code and has been written for the 1K ZX-81. It is only suitable for a ZX-81 with less than 3.25K RAM. The display occupies the bottom 15 lines of the screen, and is of the wrap-around type. That means the aeroplane is on screen at all times. It does not disappear on reaching the right-hand edge only to reappear moments later complete on the left-hand side as in some machine-code programs.

The jet appears at the top left of the display with 55 shots displayed on its body. The shots can be fired at any time by pressing any key except shift, and may be fired singly or in a salvo depending on the length of time for which the key is depressed.

Point of contact

The shots travel at twice the speed of the plane in a 45° downward direction and on hitting a tower will destroy it from the point of contact to the ground. The counter on the side of the B-52 will count down with each shot fired. To simulate the jet propulsion, the exhaust is changed from a hyphen to an asterisk with each move of the aircraft. The towers are random height and random characters to give a different game every time.

The program is written for a line 1 Rem statement containing 287 zeros. When you have written this Rem statement, enter the following hexadecimal-loader program.

```
10 LET X = 16514
20 LET A$ = ""
30 IF A$ = "" THEN INPUT A$
40 IF A$ = "S" THEN STOP
50 POKE X, 16 * CODE A$ + CODE A$ (2) -476
60 PRINT AT 11,7;X; "SPC", A$(1 to 2)
70 LET X = X + 1
80 LET A$ =      A$ (3 to)
90 GO TO 30
RUN (IN FAST)
```

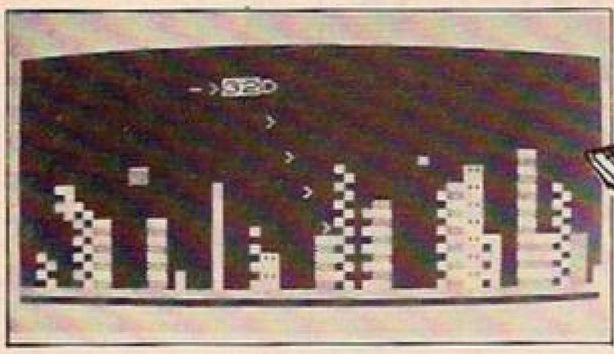
You can now enter the hexadecimal codes as in the listing, either in pairs or blocks, i.e., 80 Newline — 80 Newline — 92 Newline or 8080922121A90100 Newline and so on. Remember there are no spaces between the codes. The hexadecimal-loader program will give a display of the last address and code entered so that you can check the listing as you enter it.

I prefer to run it in fast mode because the screen flicker does give an indication that an entry has been made without having to look up from the list to check.

After the last entry, at address 16800, enter S to end. Now type the only line of Basic necessary:

```
10 RAND USR 16520
```

and delete lines 10 to 90 as these are no longer required. The ROM subroutines used are located at the same address in both the old and new 8K ROMs.



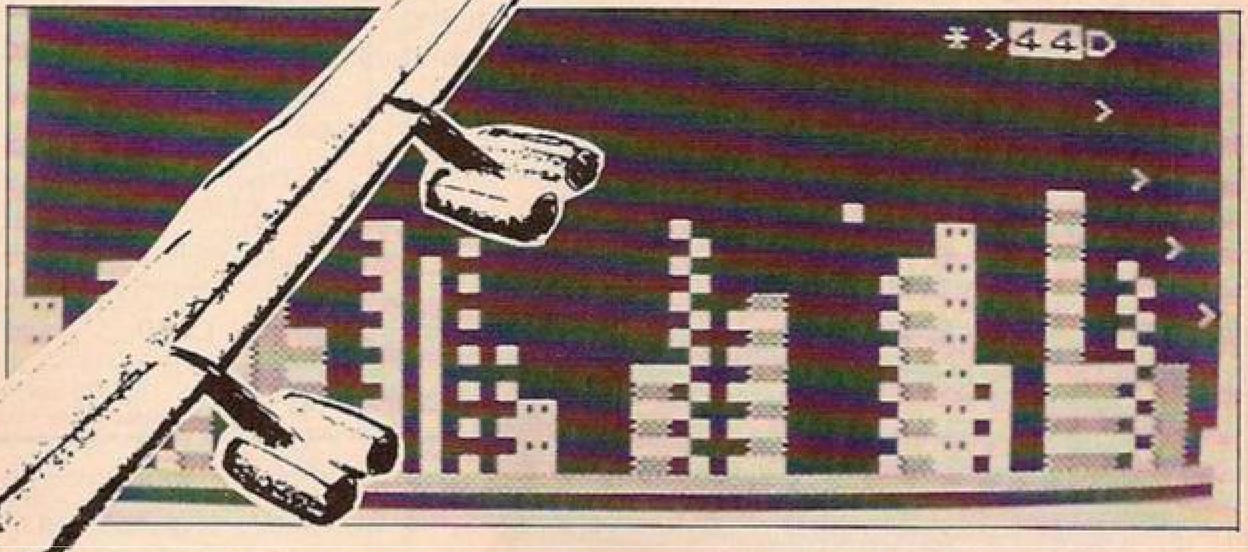


```
16514   80 80 92                         Rocket
        21 21 A9                         data
16520   01 00 07      LD BC,0700         Print black
        CD F5 08      PRINT AT           background
        11 C0 01      LD DE,01C0         starting at
        3E 80         LD A,80            line 7.
        D7            RST 10
        1B            DEC DE
        7A            LD A,D
        B3            OR E
        20 F8         JRNZ, F8
16537   06 20         LD B,20            Print last
        3E 8A         LD A,8A            line grey/
        D7            RST 10             black.
        10 FD         DJNZ, FD
16544   ED 5B 33 40   LD DE,(4033)       Random height
        2A 32 40      LD HL,(4032)       for towers.
        19            ADD HL,DE
        22 32 40      LD(4032),HL
        7C            LD A,H
        E6 07         AND 07
        C6 0D         ADD A,0D
        47            LD B,A
        C5            PUSH BC
        CD F5 08      PRINT AT           Start printing
        3A 32 40      LD A,(4032)        towers with
        E6 07         AND 07             random
        C6 04         ADD A,04           characters.
        D7            RST 10
        C1            POP BC
```

```
        78            LD A,B
        FE 14         CP 14              Finished
        28 03         JRZ,03             tower ?
        04            INC B
        18 EB         JR,EB
        79            LD A,C
        FE 1F         CP 1F              Finished 32
        28 03         JRZ,03             towers ?
        0C            INC C
        18 D2         JR D2
16590   01 00 08      LD BC,0800         Initial. rocket
16593   C5            PUSH BC            Store it.
        CD F5 08      PRINT AT           Print rocket
        11 82 40      LD DE,4082         data.
        01 06 00      LD BC,0006
        CD 6B 0B      PRINT STRING
16606   2A 10 40      LD HL,(4010)       Scan screen
        11 21 00      LD DE,0021         from bottom
        2B            DEC HL             until rocket
        E5            PUSH HL            found.
        7E            LD A,(HL)
16615   FE A9         CP A9              Found rocket?
16617   20 0E         JRNZ, 0E
        23            INC HL             Check next screen
        7E            LD A,(HL)          position for tower.
        FE 76         CP 76
        28 FA         JRZ, FA
        FE 80         CP 80
        28 29         JRZ,29
        E1            POP HL             If tower then go to
        C3 8D 41      JP,418D            crash display. 16781
16633   FE 92         CP 92              Found shot ?
        20 1E         JRNZ 1E
        36 80         LD (HL) 80         If yes-erase.
        23            INC HL             Check next column
        7E            LD A (HL)          for end of line
```

B-52





BOMB-RUN

```
       FE 76      CP 76
       28 FA      JRZ FA        If 'next' column is
       FE 8A      CP 8A         base line then do
       28 12      JRZ 12        not re print shot
       19         ADD HL DE     Move down one
       7E         LD A (HL)     line and check
       FE 80      CP 80         for black square.
       28 0A      JRZ 0A        Yes ? Goto print.
       FE 8A      CP8A          If base then
       28 08      JRZ 08        skip print
       36 80      LD (HL)80     Erase tower down
       19         ADD HL DE     to base line
       7E         LD A (HL)     (must be tower)
       18 F6      JR F6
       36 92      LD (HL) 92    Re print shot
       E1         POP HL        Get original shot
```

```
       18 C6      JR C6         postn. and goto next.
16670  E1         POP HL        Reset stack.
16671  06 04      LD B, 04      Delay
       0B         DEC BC
       78         LD A,B
       B1         OR C
       20 FB      JRNZ, FB
16678  3A 3E 40   LD A,(403E)   Scan screen twice
       3C         INC A         to move shot at
       32 3E 40   LD(403E)A     twice speed of
       CB 47      BIT 0,A       rocket.
       20 AD      JRNZ, AD
16689  3A 3C 40   LD A,(403C)   Check shots left?
       3D         DEC A
       28 36      JRZ, 36
16695  3A 25 40   LD A,(4025)   Check key pressed?
```

```
       3C         INC A
       28 30      JRZ, 30
16701  19         ADD HL, DE    Create shot on
       7E         LD A,(HL)     screen below
       FE 80      CP 80         front of rocket.
       28 0A      JRZ, 0A       If position is top
       FE 8A      CP 8A         of tower then
       28 08      JRZ, 08       erase tower.
       36 80      LD(HL)80
       19         ADD HL, DE
       7E         LD A,(HL)
       18 F6      JR, F6
       36 92      LD(HL),92     Print shot.
16719  21 86 40   LD HL, 4086   Reduce shots
       7E         LD A,(HL)     counter on rocket
       FE 1C      CP 1C         body. (part of
       20 05      JRNZ, 05      rocket data).
       36 25      LD(HL),25
       2B         DEC HL
       18 F6      JR, F6
       3D         DEC A
       77         LD(HL),A
       FE 1C      CP 1C
       20 0B      JRNZ, 0B
       2B         DEC HL
       7E         LD A,(HL)
       FE 1C      CP 1C
       20 05      JRNZ, 05
       3E 01      LD A, 01      If no shots left
       32 3C 40   LD(403C),A    then load 403C,1.
16749  C1         POP BC        Get rocket position
       0C         INC C         and move it to
       79         LD A, C       next screen
       FE 1A      CP 1A         position.
       20 07      JRNZ, 07
       78         LD A, B
       FE 14      CP 14         Check landed ?
       28 1F      JRZ, 1F       If yes go to 16792
       18 07      JR, 07
       FE 20      CP 20
       20 03      JRNZ, 03
       0E 00      LD C, 00
       04         INC B
       79         LD A, C       Change rocket flame
       E6 01      AND 01        from - to * to - etc
       C6 96      ADD A, 96     with each move of
       32 83 40   LD(4083),A    rocket.
       C3 D1 40   JP, 40D1      Goto 16593.
16781  C1         POP BC        Get rocket position
       CD F5 08   PRINT AT
       06 06      LD B, 06      Overprint 6 *'s
       3E 97      LD A, 97
       D7         RST 10
       10 FD      DJNZ, FD
16792  3E 21      LD A,21       Reset counter
       32 85 40   LD(4085),A
       32 86 40   LD(4086),A
16800  C9         RET           Return to BASIC
       BASIC      10 RAND USR 16520
```

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* Reviewed in ZX Computing Aug/Sept 1982 and Popular Computing Weekly 22/7/82.

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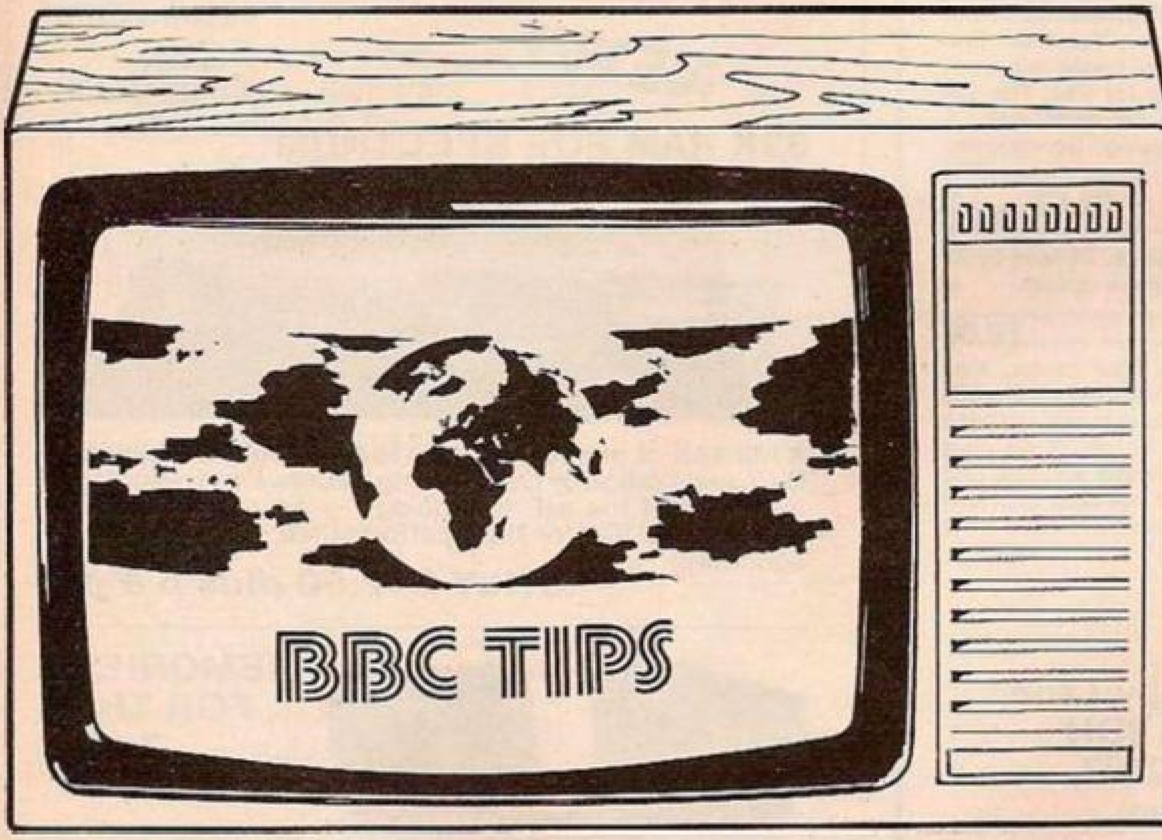
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________ YC9

The BBC *User Guide* seems somewhat inscrutable when it comes to defining some of the listed commands. Mark Holmes fills in the gaps with details of the operating-system calls. And for readers interested in creating their own graphics, Ian Thomas takes us on a tour of the BBC's special effects department.



USER-D

THE MANY POWERFUL routines built into the BBC Micro's operating system can be used for spectacular effects. One of these functions enables you to define characters to resemble anything you desire. This means that it is possible to display graphics in any mode — except for the teletext one.

This is very useful when writing a graphics game which is required to be relatively fast. The Print Tab function displays many individual graphic characters, such as space invaders, whereas the Plot command has to Plot many individual dots to build up a single character. One disadvantage of using defined characters for graphics is that all the graphics have to be in a single colour.

Any character with a code between 224 and 255 can be defined by using the VDU 23 command. VDU 23 is followed by the code of the character to be defined and by eight numbers which, in binary, represent the dark and light dots of the character. The first of the eight numbers represents the top row of the character and the eighth number represents the bottom row. Therefore the character has an eight-by-eight dot matrix.

The easiest way to find these eight numbers is to take a grid of eight by eight squares and

CALLING THE OPERA

HIGH ON THE list of the *User Guide's* inadequacies is its lack of information on the various calls to the operating system via its command-line interpreter. I studied version 0.10 of the operating system stored in EPROM to glean the details of the system commands.

The version of the operating system resident in a machine may be checked by typing in

*FX0

to which the computer will respond with the operating-system version number and its storage medium.

If you examine the operating-system code, you will see that the following commands will be recognised by the command-line interpreter.

*CAT
*DISC
*DISK
*DEBUG
*EXEC
*FX
*KEY
*LOAD
*MOTOR
*NOTAPE
*OPT
*RUN
*SAVE
*SPOOL
*TAPE
*TV

Some of these commands are adequately described in the *User Guide* but many will be new to most users. The full set of commands indicates the care and consideration which obviously went into the design of the micro and its operating system.

The commands *Disc, *Disk and *Net clearly allude to the switching in of expansion options available. When these commands are typed in, they return with a message reporting the non-availability of these filing systems. *Notape switches out the tape filing system. After typing in this command, any attempt to manipulate tape files will cause the "No filing system available" message to be printed out.

The *Exec command is described in the *User Guide* and allows a text file on tape to be read in via the screen just as if it had been typed in at the keyboard. What is not mentioned is the complementary command *Spool which allows text files to be created. This command causes all text displayed on the screen to be written to a tape file which, when *Executed, will repeat that output. For example:

```
10 *SPOOL"KEYS"
20 PRINT"*KEY0RUN | M"
30 PRINT"*KEY1LIST | M"
40 PRINT"*KEY2VDU7 | M"
50 PRINT"*KEY3WAKE UP"
60 PRINT"*KEY10WHO PRESSED BREAK"
70 *SPOOL
```

The *Spool closes the current output file and so winds up the output file "Keys".

Having created the text files saving your favourite soft key definitions, they may be "loaded" by typing in

*EXEC"KEYS"

The *Spool command may also be used to save a typing session or a program listing which appears as screen output. For instance, using the previous example in program memory, type in the following

*SPOOL"KEYSPROG"
LIST

to which the computer responds with a listing of the program.

*SPOOL

*Execution of this file will retype in the program. A slight element of untidiness emerges with this example when the List and *Spool commands generate syntax errors.

One of the great beauties of this facility is that subroutines, or procedures, and functions likely to be useful in a number of programs can be stored on tape in this form and entered into each program as required.

To close a file created by the *Spool command

CLOSE#0

may be used instead of *Spool. Close#0 will close all output files currently active and may be used as the output terminator in the previous examples.

The 50 or more *FX commands are followed by a number and optionally a pair of parameters. The *FX command is an elegant way of calling subroutines from the operating

)EFINED GRAPHICS

Program 1.

```
10 FOR I=255 TO 243 STEP-1
20 READ A,B,C,D,E,F,G,H
30 VDU23,I,A,B,C,D,E,F,G,H
40 NEXT I
50 MODE 5
60 PRINTTAB(6,12)CHR$(255);CHR$(254);CHR$(253);CHR$(252);CHR$(251);CHR$(253);CHR$(254);CHR$(255)
70 FOR I=1 TO 8
80 PRINTTAB(6+I,13)CHR$(250)
90 NEXT
100 A$=CHR$(243)+" "+CHR$(243)+" "+CHR$(243)+" "+CHR$(243)
110 PRINTTAB(6,14)A$
120 PRINTTAB(7,15)A$
130 PRINTTAB(6,16)A$
140 PRINTTAB(7,17)A$
150 FOR I=1 TO 8
160 PRINTTAB(6+I,18)CHR$(244)
170 NEXT
180 PRINTTAB(6,19)CHR$(249);CHR$(248);CHR$(247);CHR$(246);CHR$(245);CHR$(247);CHR$(248);CHR$(249)
190 DATA 0,90,126,60,60,60,126,0
200 DATA 0,8,28,46,126,46,14,0
210 DATA 0,24,52,60,24,60,126,0
220 DATA 0,90,60,24,24,60,126,0
230 DATA 0,24,60,24,90,126,126,0
240 DATA 0,0,24,60,60,24,60,0
250 DATA 255,165,129,195,195,195,129,255
260 DATA 255,247,227,209,129,209,241,255
270 DATA 255,231,203,195,231,195,129,255
280 DATA 255,165,195,231,231,195,129,255
290 DATA 255,231,195,231,165,129,129,255
300 DATA 255,255,231,195,195,231,195,255
310 DATA 255,255,255,255,255,255,255,255
1000 REM COPYRIGHT(C) IAN THOMAS 1982
```

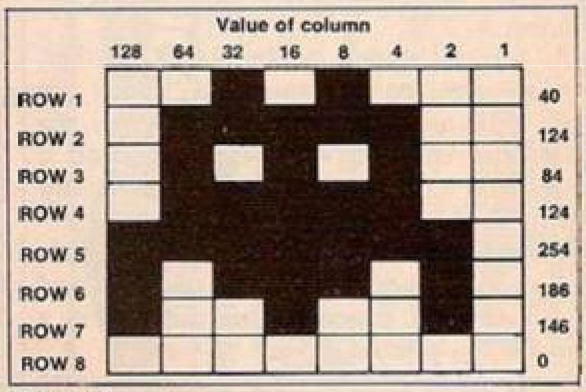


Figure 1.

draw your character on this. Start with the top row of eight squares. Add 128 for a dot in the first column, 64 for a dot in the second column, 32 in the third, right the way to 1 for a dot in the eighth column. Repeat this process for each row of eight, and you will have the eight numbers for the VDU command. Figure 1 shows this process for the space invader to be used in program 2.

For this invader to be character 255 the command is:

VDU 23,255,40,124,84,124,254,186,146,0

Here is a simple program to illustrate this:

```
10 MODE 5
20 VDU 23,255,40,124,84,124,254,186,146,0
30 PRINT TAB(10,15) CHR$(255)
```

If you enter and run this program you should see a space invader appear in the centre of the screen. Try changing the last eight numbers in the VDU command to create some of your own characters.

In line 30 of the program the Chr$ function is used to Print the character, but this is not vital. Instead of using Chr$, the program could be run without line 30 and the character could be printed by:

PRINT CHR$(255)

Line 30 could now be entered, but instead of the Chr$(255) quotation marks could be used, and the character could be copied into the in by the cursor control and copy keys. The line would now read:

30 PRINT TAB(10,15)"*"

where the asterisk represents the character which has been defined. Unfortunately the character definitions are not remembered when the program is saved, so the command must appear within the program, and must not be erased once the character has been defined.

Program 1 uses character definition to create a complete set of chess graphics, printing them out as it does so. Program 2 is a simple Space Invaders game which uses defined characters mainly because ordinary graphics and Plotting would be much too slow without resorting to complicated assembler routines.

This second program also uses the sound command, which I mention here because the syntax for this command is not included in the provisional manual which is at present supplied with the computer.

After the command Sound are four numbers which determine what the sound is like. The first number specifies the channel. This must be a number between 0 and 3. Channel 0 is a channel which only produces white noise, so it

(continued on next page)

TING SYSTEM

system. A few of the available FX commands are described in the *User Guide*, but here are a few which are not:

- *FX9,n Sets flash period of first colour of a flashing colour.
- *FX10,n Sets flash period of second colour.
- *FX11,n Sets auto-repeat delay for keyboard.
- *FX12,n Sets auto-repeat rate.
- *FX11,0 Will switch off the keyboard auto-repeat.
- *FX12,0 Restores the auto-repeat default values.

Operation of the cassette motor relay is allowed independently using the *Motor command. *Motor1 closes the relay and *Motor opens the relay.

Anyone like me who has spent hours trying to adjust his television set so that the VDU display sits squarely inside the screen with the top line of the display actually visible will curse Acorn for not explaining the *TV command.

This command allows the VDU display to be moved up or down the television or monitor screen. Typing in *TV1 followed by a Mode statement will restore the line previously lost off the bottom of the display. *TV255 will move the display down one line thus restoring the missing top line when the Mode is next changed. 255 represents -1 in a two's complement representation; 254 is -2, 253 is -3, etc.

The screen may be moved up a maximum of three lines and down considerably further depending on the vertical hold properties of the television being used. A parameter may also be passed with a *TV command to turn off interlace in Modes 0 to 6 inclusive. For example, *TV0,1 will turn off interlace.

A value of 1 will turn off interlace and 0 will restore interlace. Interlace, for those who have not encountered it, is a technique by which characters can be rendered less angular by drawing each scan line of the television alternately between adjacent scan lines of the screen.

The effect is to move the entire screen up and down rapidly by about 0.5mm. In practice, I find that I can hardly notice if interlace is on or off. In Mode 7 interlace cannot be turned off by this method. Teletext hardware relies on the fact that interlace is on.

The *OPT command is briefly mentioned in the *Guide*. Typing in *OPT1 or *OPT1,0 switches off all messages from the filing system and *OPT restores them. *OPT1,2 expands the information contained in the tape filing system messages so that on reaching the final block, the start address of the *file* is printed and the execution address specified by a *Saved program — a Basic program or a text file repeats the start address in this field. The default option is *OPT1,1.

The *Debug command has eluded all attempts to fathom its purpose. It has a most promising title and I look forward to hearing from anyone who can tell me about it. ■

(continued from previous page)

cannot be used to produce clean notes.

The second number specifies the volume of the sound. This can be any number between −15 and 0. The loudest is −15 and the quietest is 0. The third number specifies the frequency of the sound. This must be in the range 0 to 255, and unfortunately bears no resemblance to the frequency of the sound produced.

The fourth and final number specifies the duration of the sound, in the same way as the duration in the Inkeys command. A 1 for this number specifies one-hundredth of a second, so to find the duration in seconds divide this number by 100.

All of the channels can be played together, so chords are possible, but one channel can play only one note at a time. When the interpreter encounters a Sound command it stores it in a buffer until the sound generator has finished playing the previous note.

The Sound command is used in the program as a warning noise at the start of the game, and to infuriate you, when the game is over, with a horrible low-pitched noise.

Lines 30 to 70 define the characters to be used in the program. Character 255 is the missile base, 254 is the bomb or missile, 253 is the invader and together 252 and 251 make up a UFO.

Lines 110 to 130 produce the warning noise in channel 1. In line 150 an asterisk represents an invader — Chr$(253) — which must be copied into the line by use of the cursor control and copy keys. There are eight invaders and nine spaces in line 150, making 17 characters for A$(I).

You may be puzzled by line 270, *FX15,0, which clears the input buffer. This is needed because the BBC computer remembers what you type in, and if you keep your finger on a key for too long without this command you would have to wait a long time before the program recognised that you were pressing another key.

In lines 340 and 350 logical operations are used. If what appears within the brackets is true then the value of what appears in the brackets is equal to −1; if it is false then it is equal to 0.

When you run the program you should hear the warning noise, then the invaders appear. These must all be shot down before they reach the bottom of the screen. For each invader you shoot down a random score of between 100 and 500 is added to your total. Your total score is displayed in the middle of the top of the screen. When you have succeeded in shooting all 40 invaders another 40 appear, and the game gradually grows faster as you progress. At random intervals a UFO moves across the top of the screen. If you shoot this down you get a bonus of 1,000.

Invaders drop bombs randomly. If one hits your base you lose one of your three lives. The number of remaining lives is displayed at the top right of the screen. The game is over when you have no lives left, or if the invaders reach the bottom of the screen. You cannot shoot down bombs which have been dropped, nor can you shoot if you have a missile still in play. To move your base press the Z to go left and M to go right. To shoot a missile press V. ■

```
10 HS=0
20 MODE 5
30 VDU23,255,16,16,56,56,255,255,0,0
40 VDU23,254,0,0,16,16,16,16,0,0
50 VDU23,253,40,124,84,124,254,186,146,0
60 VDU23,252,15,31,50,255,255,63,31,15
70 VDU23,251,240,248,76,255,255,252,248,240
80 DIM A$(5),X(5),Y(5)
90 S=0:X=10:Y=7:Z=0:D=3:L=3:A=30:B=0:U=10
100 FOR I=1 TO 20
110 SOUND1,-15,200,1
120 A$=INKEY$(5)
130 NEXT
140 FOR I=1 TO 5
150 A$(I)=" * * * * * * * * "
160 X(I)=0:Y(I)=I*2+8
170 PRINTTAB(X(I),Y(I))A$(I)
180 NEXT
185 F=1
190 FOR I=1 TO 5
200 IF A$(I)="" N=N+1
210 IF A$(I)>"" PRINTTAB(X(I),Y(I))"  (17 SPACES)   "
220 A$=INKEY$(D)
230 X(I)=X(I9+F
240 IF X(I)=0 Y(I)=Y(I)+0.5
250 SOUND0,-15,250,5
260 IF A$(I)>"" PRINTTAB(X(I),Y(I))A$(I)
270 *FX15,0
280 IF Y(I)=30 AND A$(I)>"" GOTO 630
290 PRINTTAB(B,A-1)" ":IF A=30 AND B=X+1 L=L-1:IF L=0 GOTO 630
300 IF A=30 A=20:B=RND(19)
310 IF B=0 GOTO 300 ELSE PRINTTAB(B,A)"CHR$(254)"
320 A=A+1
330 IF A$="" A$=INKEY$(D)
340 X=X+(A$="Z")-(A$="M")
350 X=X+(X=17)-(X=0)
360 PRINTTAB(X,30)" CHR$(255) "
370 IF A$="V" AND Y=7 Y=29:Z=X+1:SOUND0,-15,255,10
380 IF Y=8 AND(Z=U OR Z=U+1) PRINTTAB(U,8)"  ":S=S+1000:U=18
390 PRINTTAB(Z,Y)" "
400 IF Y>7 Y=Y-1
410 IF Y>7 PRINTTAB(Z,Y)"CHR$(254)"
420 FOR J=5 TO 1 STEP -1
430 IF A$(J)="   (17 SPACES)   " A$(J)=""
440 IF INT(Y(J))<>Y NEXT:GOTO 520
450 C=(Z-X(J))+1
460 A$=MID$(A$(J),C,1)
470 IF A$<>"CHR$(253)" NEXT:GOTO 520
480 S=S+RND(5)*100
490 A$(J)=LEFT$(A$(J),(C-1))+" "+RIGHT$(A$(J),(17-C))
500 D=(D/50)*49
510 PRINTTAB(Z,Y)" ":Y=7
520 NEXT I:IF N=5 GOTO 610
530 PRINTTAB(U,8)"  "
540 IF X(1)=0 OR X(1)=3 F=F*-1
550 IF U<18 U=U+1
560 IF U=18 AND RND(5)>4 U=0
570 N=0
580 IF U<18 PRINTTAB(U,8)"CHR$(252)CHR$(251)"
590 PRINTTAB(7,5) S;SPC(4);L
600 GOTO 190
610 D=D-1
620 GOTO 140
630 FOR I=1 TO 30
640 SOUND0,-15,250,3
650 A$=INKEY$(10)
660 NEXT
670 IF S>HS HS=S
680 CLS
690 PRINTTAB(0,10)"HIGH SCORE ";HS
700 IF INKEY$(10)="" GOTO 700 ELSE GOTO 90
```

Program 2.

dk'tronics ZX 80/81 SPECTRUM Hardware Software

ZX KEYBOARD

The case is large enough for both the computer (81 or Spectrum) and the power supply to fit inside. **Requires no soldering**



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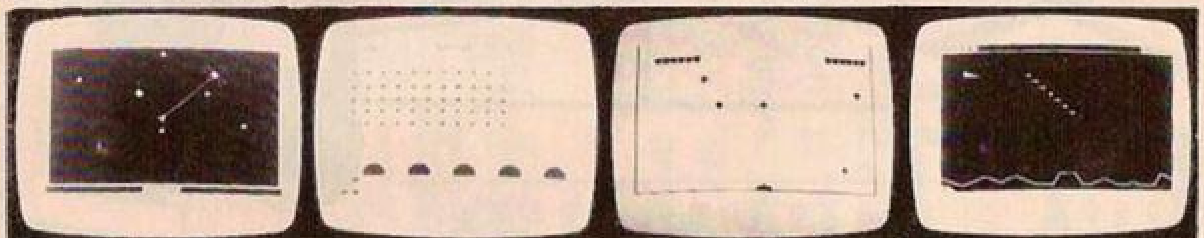
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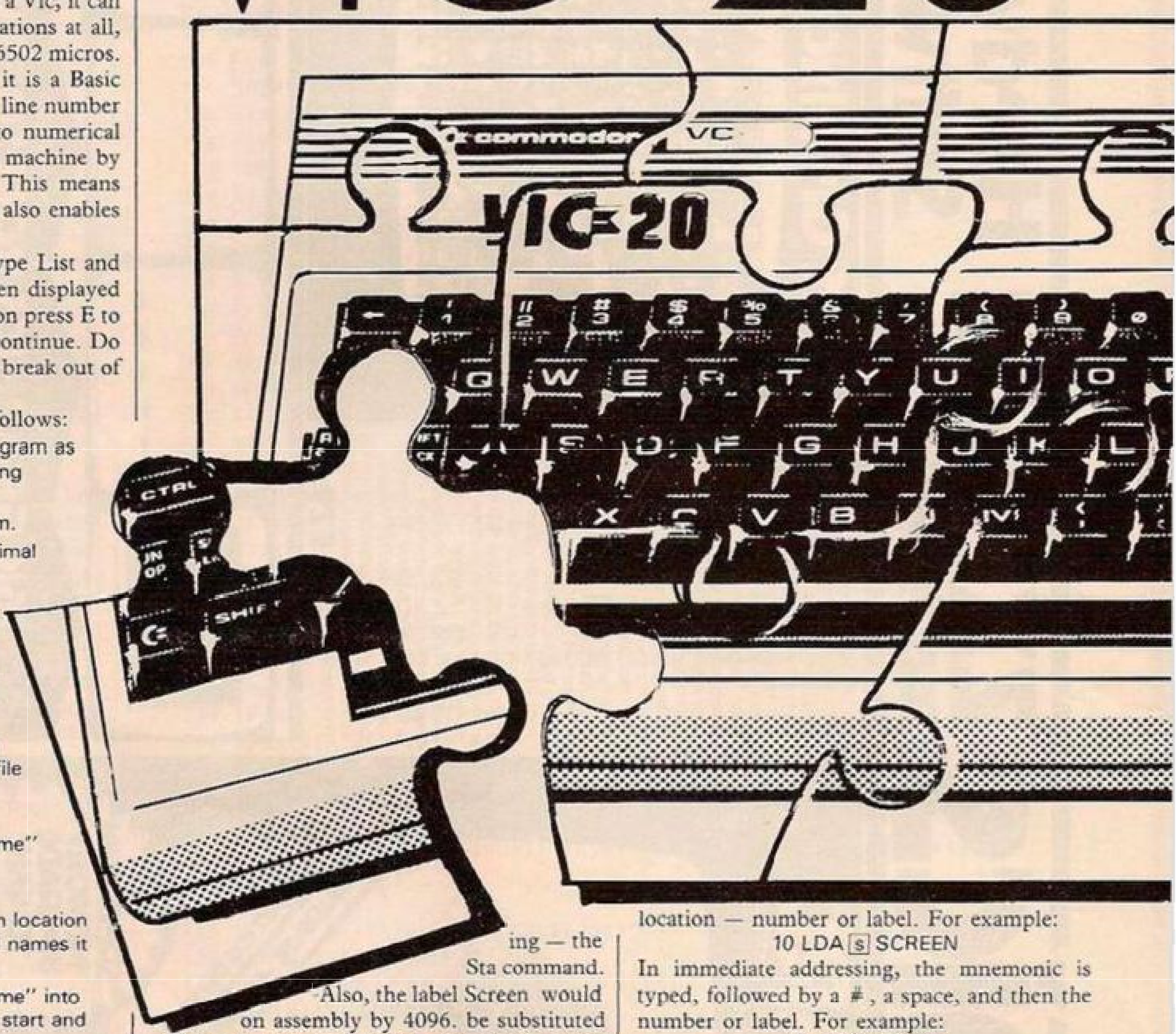
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VIC-20



THIS ASSEMBLER was developed on a Vic-20 with 16K RAM pack. The program occupies slightly less than 9K but requires more than 13K to run. I have found that the best way to store the assembled code is near the top of memory — locations 53 to 56 on the Vic — Poked low because string variables grow downwards and can interfere.

Although it has been written on a Vic, it can be entered on a Pet with no alterations at all, and with little alteration on most 6502 micros. The source code is entered as if it is a Basic program — that is, each line has a line number and the assembler sorts these into numerical order. The lines are input to the machine by opening a file to the keyboard. This means that there is no "?" prompt, and also enables screen editing.

To list your whole program, type List and press Return. The program is then displayed 15 lines at a time. After each section press E to stop listing, or any other key to continue. Do not press the Stop key as you will break out of the assembler, not the listing.

Other direct commands are as follows:

LISTx	will display the program as above, but beginning at line x.
NEW	clears your program.
ASSEMBLE	displays a hexadecimal assembly of your program.
ASSEMBLEM	as above, but also loads the machine code into memory, as specified within the source code.
SAVE "program name"	outputs the source code to tape as a file named "program name".
LOAD "program name"	loads "program name" from tape.
*SAVE "program name" x-y	saves memory from location x to location y and names it "program name".
*LOAD "program name"	loads "program name" into memory, returning start and end addresses.
DISASSx	disassembles from location x, codes as for the assembler. One screen is displayed at a time. Hit E to end or any other key to continue.
?Hx	returns the hexadecimal value of the denary number x.
?Dx	returns denary value of hexadecimal x.
END	exits the assembler.

Commands are not altogether standard, and spaces are very important — they enable the main assembler routines to split each line into its different sections. Necessary spaces are marked here as [s]. Numbers can be entered in three different forms — as labels, denary or hexadecimal numbers. Labels are preceded by a full stop, and hexadecimal numbers by a $. Labels can be defined as follows:

```
10DL[s]SCREEN[s]4096
```

This defines a label called Screen, and sets it equal to the denary number 4096. Alternatively:

```
20 .LOOP[s]STA[s] .SCREEN
```

On reaching this line, the label Loop is set equal to the location of the command following — the Sta command.

Also, the label Screen would on assembly by 4096. be substituted

You are not confined to calculating your own location values. Up to 10 numbers or can follow the commands. For example:

```
20 .LOOP[s]STA[s] .SCREEN+$FF-200
```

This will be calculated by the assembler to give 4151 denary.

To enter a series of letters or graphics, the Byt command is used. This has two alternatives:

```
10 BYT 'THIS IS A TEST
```

The apostrophe before "This" tells the assembler to use ASCII codes.

```
20 BYT PTHIS IS A TEST
```

The P tells the assembler to use CBM screen codes. Branching can be done to either a label or a specified location.

To specify the load location the "*=" command is used. For example,

```
10 *= s 675
```

continues assembly from 675 denary.

```
50 *= s $fff
```

continues assembly from fff hexadecimal. The last line of the source code must be an End command, otherwise the program will loop indefinitely.

For absolute addressing the mnemonic is typed, followed by a space and then the location — number or label. For example:

```
10 LDA[s]SCREEN
```

In immediate addressing, the mnemonic is typed, followed by a #, a space, and then the number or label. For example:

```
10 LDX# [s]200
```

For absolute indexed addressing, the index register to be used is placed immediately after the mnemonic, then a space, then the location. For example:

```
10 LDAX[s]1000
20 INCY[s].LOC
```

With zero-page addressing, a Z follows the mnemonic, before any index register:

```
10 LDAZ[s]100
20 DECZX[s]100
```

In indirect addressing, the index register required is placed in brackets after the mnemonic:

```
10 LDA(Y)[s]100
20 STA(X)[s]150
```

An indirect jump has an I in brackets:

```
10 JMP(I)[s]2000
```

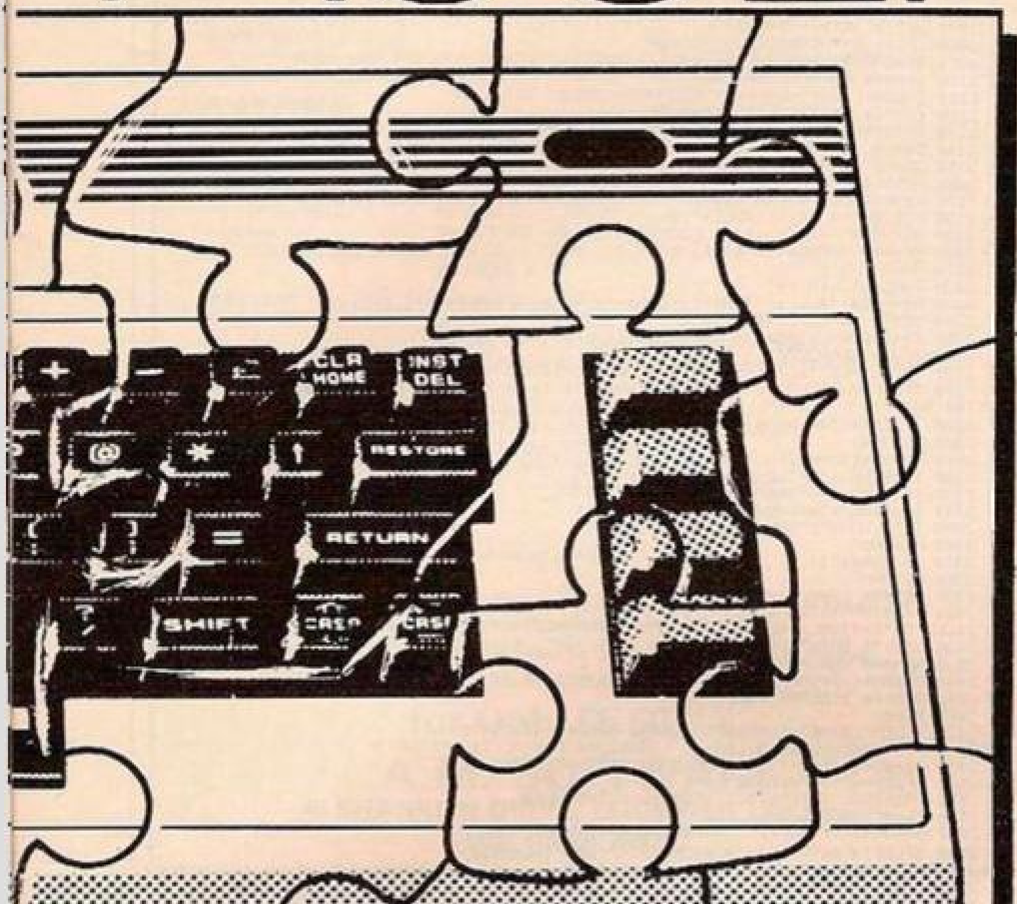
For accumulator addressing, the shift and rotate instructions to be carried out on the accumulator are followed by an A:

```
10 LSRA
20 ROLA
```

Here are the main sections of the program:

10 to 70	read mnemonic data and number of bytes per command.
100 to 440	run through your program and supply each line with its memory

ASSEMBLER



This 6502 assembler, written by Philip Horton, is not solely applicable to Vic machines. Numbers can be entered as denary, hex numbers, or as labels — and you are not confined to calculating your own location values.

```
10 CLR:PRINT"J":DIML$(200),A%(255),LA$(50),P(50),D%(200),C$(200)
20 DIMA$(255):FORJ=0TO254:READA$(J):NEXT
30 FORJ=0TO255:IFA$(J)<>""THENREADA%(J)
40 NEXT
50 PRINT"JM    6502 ASSEMBLER"
60 PRINT"
70 PRINT"(C) P.J. HORTON 1982M"
80 GOTO1410:REM*** INPUT ROUTINE ***
90 J=0
100 REM*** SETUP FOR ASSEMBLY ***
110 J=J+1:C=0:D%(J)=D
```

```
120 IFLEFT$(L$(J),1)="."THEN370
130 IFL$(J)="END"THEN450
140 C=C+1:IFC>LEN(L$(J))THEN190
150 IFMID$(L$(J),C,1)<>" "THENC$(J)=C$(J)+MID$(L$(J),C,1):GOTO140
160 IFC$(J)="BYT"THENGOSUB1050:GOTO110
170 IFC$(J)="*="THENGOSUB230:GOTO110
180 IFC$(J)="DL"THENGOSUB290:GOTO110
190 FORF=0TO255
200 IFC$(J)<>A$(F)THENNEXT:PRINT:PRINT"?SYNTAX ERROR IN";:ER=1:GOTO1900
210 D=D+A%(F)
220 GOTO110
230 REM*** NEW MEM LOC ***
240 FORK=1TOLEN(L$(J)):IFMID$(L$(J),K,1)<>" "THENNEXT:PRINT"?SYNTAX ERROR IN";
ER=1:GOTO1900
250 T$=RIGHT$(L$(J),LEN(L$(J))-K)
260 C$(J)="M"
270 GOSUB2200
280 D=VAL(T$):AD=D:RETURN
290 REM*** DEF LABEL ***
300 NL=NL+1:C=3
310 C=C+1:IFMID$(L$(J),C,1)<>" "THENLA$(NL)=LA$(NL)+MID$(L$(J),C,1):GOTO310
320 T$=RIGHT$(L$(J),LEN(L$(J))-C):GOSUB2200:P(NL)=VAL(T$)
330 IFNL=1THEN360
340 FORF=1TONL-1:IFLA$(F)=LA$(NL)THENPRINT"MLABEL REPEATED IN";:ER=1:GOTO1900
350 NEXT
360 RETURN
370 REM*** LABEL ***
380 NL=NL+1:C=1
390 C=C+1:IFMID$(L$(J),C,1)<>" "THENLA$(NL)=LA$(NL)+MID$(L$(J),C,1):GOTO390
400 IFNL=1THEN430
410 FORF=1TONL-1:IFLA$(F)=LA$(NL)THENPRINT"MLABEL REPEATED IN";:ER=1:GOTO1900
420 NEXT
430 P(NL)=D
440 GOTO140
450 REM*** ASSEMBLE ***
460 PRINT"M  LOC         CODE":SC=0
470 N=0
480 PRINT:FORF=1TOJ-1
490 IFC$(F)="M"THENAD=D%(F+1):GOTO700
500 IFC$(F)="DL"THEN700
510 IFC$(F)="B"THENGOSUB1090:GOTO690
520 PRINT:PRINTD%(F),:N=N+1
530 FORK=0TO255:IFA$(K)<>C$(F)THENNEXT
540 DN=K:GOSUB740
550 PRINTTAB(12);H$;
560 IFLA=1THENGOSUB1350
570 IFA%(K)=1THENPRINT:GOTO690
580 IFLEFT$(C$(F),1)="B"ANDC$(F)<>"BIT"THENGOSUB850:GOTO690
590 IFA%(K)=2THENGOSUB940:GOTO690
600 REM*** 2 BYTE JMP ETC. ***
610 FORK=LEN(L$(F))TO1STEP-1:IFMID$(L$(F),K,1)<>" "THENNEXT
620 T$=RIGHT$(L$(F),LEN(L$(F))-K)
630 GOSUB2200
640 T=VAL(T$):D1=INT(T/256):D2=T-D1*256
650 DN=D2:GOSUB740:PRINTTAB(15);H$;
660 IFLA=1THENGOSUB1350
```

(continued on next page)

location, and also set up any labels — either defined or from a full-stop command.

- **450 to 1400** assemble your program, into memory if required. These lines include:
- **740 to 840** denary to hex converter for numbers up to 65535 — FFFF.
- **1010 to 1040** hex to denary converter.
- **1290** this line converts a letter or graphic into CBM screen Poke codes.
- **1410 to 2190** contain the input routine which accesses all other parts of the assembler.
- **2200 to 2380** one subroutine used by all parts of the program to convert the string T$ to a denary number. It is returned as T$.
- **2450 to 2660** are where the disassembler is accessed by the input routine.
- **2660** is where the CHR$ commands open inverted commas and then delete them. This prevents, for example, a clear screen command from interfering with any printout.
- **2670 to 2890** are the subroutines which output memory to tape and vice versa.
- **2900 to 3150** hold mnemonic data and data to give the number of bytes required by each command.

Now here are the variables:

- **A$(n)** 6502 mnemonics.
- **A%(n)** number of bytes required by each of the commands.
- **L$(n)** each line of your program.
- **C$(n)** the command on each line of your program.
- **D%(n)** the location of each line of your program in memory.

Each of the last three arrays are Dimensioned to 200 elements, but this can be altered as required, by changing line 10.

- **NL** the number of labels so far encountered.
- **LA$(n)** the names of the above labels.
- **P(n)** the location in memory of each of the above labels.

The label arrays are Dimensioned to 50 elements, but can also be altered as required at line 10.

- **L$** the line that the input routine is currently working on.
- **N** the number of lines in your program.
- **DN** denary number for conversions.
- **H$** hex number for conversions.
- **LA** flag used to give "Load on assembly".
- **C** counter used to control the position in the line of program that the assembler is dealing with.
- **ER** error report flag, to give a line number after an error in the source code.
- **SC** the number of lines so far printed on the screen for List, Disass, etc.

Finally, here are the error reports.

SYNTAX ERROR	A direct command has not been understood.
SYNTAX ERROR IN x	There is a mistake in line x of the source code.
LABEL REPEATED IN x	The label defined in line x has already been used in the code.
NO SUCH LABEL IN x	The label mentioned in line x has not been defined.
NO CODE ERROR	The user has tried assembling with no code in the memory.

(continued from previous page)

```
670 DN=D1:GOSUB740:PRINTTAB(13);H$
680 IFLA=1THENGOSUB1350
690 SC=SC+1:IFSC=11THENGOSUB720
700 NEXTF:GOTO1380
710 REM*** SCREEN FULL ***
720 GETZ$:IFZ$=""THEN720
730 PRINT"J":SC=0:RETURN
740 REM*** DEC-HEX ***
750 N1=INT(DN/4096)
760 D2=DN-N1*4096:N2=INT(D2/256)
770 D2=D2-N2*256:N3=INT(D2/16)
780 D2=D2-N3*16:N4=D2
790 H$=CHR$(N1+48-(N1>9)*7)
800 H$=H$+CHR$(N2+48-(N2>9)*7)
810 H$=H$+CHR$(N3+48-(N3>9)*7)
820 H$=H$+CHR$(N4+48-(N4>9)*7)
830 IFLEFT$(H$,1)="0"ANDLEN(H$)>2THENH$=RIGHT$(H$,LEN(H$)-1):GOTO830
840 RETURN
850 REM*** BRANCH ***
860 FORK=LEN(L$(F))TO1STEP-1:IFMID$(L$(F),K,1)<>" "THENNEXT
870 T$=RIGHT$(L$(F),LEN(L$(F))-K)
880 GOSUB2200
890 DN=VAL(T$):T=D%(F):IFDN>TTHENDN=DN-T-2:GOTO910
900 DN=255-(T-DN+1)
910 GOSUB740:PRINTTAB(15);H$
920 IFLA=1THENGOSUB1350
930 RETURN
940 REM*** 1 BYTE JMP ETC. ***
950 FORK=LEN(L$(F))TO1STEP-1:IFMID$(L$(F),K,1)<>" "THENNEXT
960 T$=RIGHT$(L$(F),LEN(L$(F))-K)
970 GOSUB2200
980 DN=VAL(T$):GOSUB740:PRINTTAB(15);H$
990 IFLA=1THENGOSUB1350
1000 RETURN
1010 REM*** HEX-DEC ***
1020 DN=0:FORH=1TOLEN(H$)
1030 DN=DN+(ASC(MID$(H$,H,1))-48+(ASC(MID$(H$,H,1))>57)*7)*(16↑(LEN(H$)-H)):NEXTH
1040 RETURN
1050 REM*** BYT ***
1060 FORK=LEN(L$(J))TO1STEP-1:IFMID$(L$(J),K,1)<>" "ANDMID$(L$(J),K,1)<>"B"THENNEXT:GOTO1080
1070 D=D+LEN(L$(J))-K:C$(J)="B":RETURN
1080 PRINT:PRINT"?SYNTAX ERROR IN";:ER=1:GOTO1900
1090 REM*** ASSEMBLE BYT ***
1100 FORJ=LEN(L$(F))TO1STEP-1:IFMID$(L$(F),J,1)=" "THEN1130
1110 IFMID$(L$(F),J,1)="P"THEN1250
1120 NEXT:GOTO1200
1130 B$=RIGHT$(L$(F),LEN(L$(F))-J)
1140 FORJ=1TOLEN(B$):PRINT
1150 PRINTD%(F)+J-1;:DN=ASC(MID$(B$,J,1)):GOSUB740:PRINTTAB(12);H$
1160 IFTP=1THENPRINT#1,H$
1170 IFLA=1THENGOSUB1350
1180 SC=SC+1:IFSC=11THENGOSUB720
1190 NEXT:RETURN
1200 REM*** NUMBER ***
1210 T$=RIGHT$(L$(F),LEN(L$(F))-J)
1220 GOSUB2200
1230 DN=VAL(T$):GOSUB740:PRINTTAB(12);H$
1240 IFLA=1THENGOSUB1350
1250 REM*** POKE ALPHA ***
1260 B$=RIGHT$(L$(F),LEN(L$(F))-J)
1270 FORJ=1TOLEN(B$):PRINT
1280 PRINTD%(F)+J-1;TAB(12);
1290 DN=(ASC(MID$(B$,J,1))AND128)/2OR(ASC(MID$(B$,J,1))AND63)
1300 GOSUB740:PRINTTAB(12);H$
1310 IFTP=1THENPRINT#1,H$
1320 IFLA=1THENGOSUB1350
1330 SC=SC+1:IFSC=11THENGOSUB720
1340 NEXT:RETURN
1350 REM*** ASSEMBLER LOADER ***
1360 IFDN>255THENPRINT:PRINT"NUMBER TOO LARGE IN";:ER=1:GOTO1900
1370 POKEAD,DN:AD=AD+1:RETURN
1380 REM*** END ***
1390 IFTP=1THENPRINT#1,"END":CLOSE1
1400 GOSUB720:GOTO1900
1410 REM*** INPUT ***
1420 REM
1430 OPEN2,0
1440 PRINT"READY."
1450 INPUT#2,L$:PRINT
1460 IFL$="NEW"THENFORJ=1TON:L$(J)="":NEXT:N=0:GOTO1440
1470 IFLEFT$(L$,4)="LIST"THEN1980
1480 IFL$="END"THENPRINT"J":END
1490 IFLEFT$(L$,6)="DISASS"THEN2450
1500 IFLEFT$(L$,1)="?"THEN2100
1510 IFLEFT$(L$,8)="ASSEMBLE"THEN1800
1520 IFLEFT$(L$,4)="LOAD"THEN1700
1530 IFLEFT$(L$,5)="*LOAD"THEN2790
1540 IFLEFT$(L$,4)="SAVE"THEN1750
1550 IFLEFT$(L$,5)="*SAVE"THEN2670
1560 N1=VAL(L$):IFN1=0THENPRINT:PRINT"?SYNTAX ERROR":GOTO1450
1570 IFLEN(STR$(VAL(L$)))-1=LEN(L$)THEN1650
1580 N=N+1:IFN=1THENL$(1)=L$:GOTO1450
1590 FORJ=1TON-1:IFVAL(L$(J))<N1THENNEXT
1600 IFVAL(L$(J))=N1THENL$(J)=L$:N=N-1:GOTO1450
1610 FORK=NTOJSTEP-1
1620 L$(K)=L$(K-1):NEXT
1630 L$(J)=L$
1640 GOTO1450
1650 REM*** SPLAT LINE ***
1660 FORK=1TON:IFVAL(L$(K))<>VAL(L$)THENNEXT:GOTO1450
1670 FORL=KTON:L$(L)=L$(L+1):NEXT:N=N-1
1680 IFN<0THENN=0
1690 GOTO1450
1700 REM*** LOAD ***
1710 OPEN1,1,0,RIGHT$(L$,LEN(L$)-4)
1720 INPUT#1,N:FORJ=1TON
1730 INPUT#1,L$(J):NEXT
1740 CLOSE1:PRINT:PRINT"READY.":GOTO1450
1750 REM*** SAVE ***
1760 OPEN1,1,1,RIGHT$(L$,LEN(L$)-4)
1770 PRINT#1,N:FORJ=1TON
1780 PRINT#1,L$(J):NEXT
1790 CLOSE1:PRINT:PRINT"READY.":GOTO1450
1800 REM*** ENTERED ***
1810 LA=0
1820 IFRIGHT$(L$,1)="M"THENLA=1
1830 IFN=0THENPRINT"*NO CODE ERROR":GOTO1440
1840 PRINT:PRINT"* WORKING..."
1850 FORJ=1TON
1860 NC=VAL(L$(J)):NC=LEN(STR$(NC))-1
1870 L$(J)=RIGHT$(L$(J),LEN(L$(J))-NC)
1880 IFLEFT$(L$(J),1)=" "THENL$(J)=RIGHT$(L$(J),LEN(L$(J))-1):GOTO1880
1890 NEXTJ:SN=N:GOTO90
1900 REM*** RENUM&CONT ***
1910 IFER=1THENER=0:PRINT10*J
1920 IFE2=1THENE2=0:PRINT10*F
1930 N=SN:FORJ=1TON:L$(J)=STR$(10*J)+" "+L$(J):D$(J)=""
1940 L$(J)=RIGHT$(L$(J),LEN(L$(J))-1):NEXT
1950 FORJ=1TONL:LA$(J)="":P(J)=0:NEXT:NL=0
1960 PRINT"K"
1970 GOTO1440
1980 REM*** LIST ***
1990 SC=0
2000 IFL$="LIST"THENSL=1:GOTO2040
2010 SL=VAL(RIGHT$(L$,LEN(L$)-4))
2020 FORJ=1TON:IFSL>VAL(L$(J))THENNEXT:GOTO1440
2030 SL=J
2040 FORJ=SLTON:PRINTL$(J)
2050 SC=SC+1:IFSC=15THEN2070
2060 NEXT:GOTO1440
2070 GETZ$:IFZ$=""THEN2070
2080 IFZ$="E"THENPRINT:GOTO1440
2090 SC=0:GOTO2060
2100 REM*** CONVERSIONS ***
2110 IFLEN(L$)<3THENPRINT"K?SYNTAX ERROR":GOTO1440
2120 IFMID$(L$,2,1)="D"THEN2170
2130 IFMID$(L$,2,1)<>"H"THENPRINT"K?SYNTAX ERROR":GOTO1440
2140 DN=VAL(RIGHT$(L$,LEN(L$)-2))
2150 GOSUB740:PRINT"*HEX=";H$
2160 GOTO1440
2170 H$=RIGHT$(L$,LEN(L$)-2)
2180 GOSUB1010:PRINT"*DEC=";DN
2190 GOTO1440
2200 REM*** NUMBER T$ ***
2210 NN=0
2220 FORL=2TOLEN(T$)
2230 A$=MID$(T$,L,1):IFA$="+"ORA$="-"ORA$="*"ORA$="/"THEN2440
2240 NEXTL:NN=NN+1:T$(NN)=T$
2250 FI=0:FORNU=1TONN
2260 IFNU=1THEN2280
2270 S$(NU)=LEFT$(T$(NU),1):T$(NU)=RIGHT$(T$(NU),LEN(T$(NU))-1)
2280 IFLEFT$(T$(NU),1)="$"THENH$=RIGHT$(T$(NU),LEN(T$(NU))-1):GOSUB1010:T$(NU)=STR$(DN)
2290 IFLEFT$(T$(NU),1)="."THEN2400
2300 NEXTNU
2310 FORNU=1TONN:IFNU=1THENFI=VAL(T$(1)):GOTO2360
2320 IFS$(NU)="+"THENFI=FI+VAL(T$(NU))
2330 IFS$(NU)="-"THENFI=FI-VAL(T$(NU))
2340 IFS$(NU)="*"THENFI=FI*VAL(T$(NU))
2350 IFS$(NU)="/"THENFI=FI/VAL(T$(NU))
2360 NEXTNU
2370 T$=STR$(FI)
2380 RETURN
2390 REM*** LABEL ***
2400 A$=RIGHT$(T$(NU),LEN(T$(NU))-1)
2410 FORTE=1TONL:IFLA$(TE)=A$THENT$(NU)=STR$(P(TE)):GOTO2300
2420 NEXTTE:PRINT:PRINT"NO SUCH LABEL IN";:E2=1:GOTO1900
2430 REM*** NEW NO ***
2440 NN=NN+1:T$(NN)=LEFT$(T$,L-1):T$=RIGHT$(T$,LEN(T$)-L+1):GOTO2220
2450 REM*** DISSASS ***
2460 SC=0
2470 IFLEN(L$)=6THENPRINT"?SYNTAX ERROR":GOTO1440
2480 T$=RIGHT$(L$,LEN(L$)-6):GOSUB2200:D2=VAL(T$):PRINT"J"
2490 SC=SC+1:IFSC=11THENGOSUB720:IFZ$="E"THEN1440
2500 IFD2>=65535THEN63999
2510 PRINTD2;:A=PEEK(D2):IFA$(A)=""THEN2660
2520 PRINTTAB(7)A$(A);
2530 IFA%(A)=1THENPRINT:GOTO2590
2540 IFLEFT$(A$(A),1)="B"ANDA$(A)<>"BRK"THEN2610
2550 IFA%(A)=2THENDN=PEEK(D2+1):D2=D2+2
2560 IFA%(A)=3THENDN=PEEK(D2+1)+(PEEK(D2+2)*256):D2=D2+3
2570 PRINTTAB(13);DN
2580 PRINT:GOTO2490
2590 D2=D2+1
2600 PRINT:GOTO2490
2610 REM*** BRANCH ***
2620 IFPEEK(D2+1)>127THEN2640
2630 DN=D2+PEEK(D2+1)+2:D2=D2+2:GOTO2570
2640 REM*** BACK ***
2650 DN=D2-(255-(PEEK(D2+1)+1)):D2=D2+2:GOTO2570
2660 PRINTTAB(7);"BYT";TAB(14);CHR$(34);CHR$(20);CHR$(A):GOTO2590
2670 REM*** MEM-TAPE ***
2680 FORJ=6TOLEN(L$):IFMID$(L$,J,1)<>CHR$(34)THENNEXT:PRINT"?SYNTAX ERROR":GOTO1440
2690 NS=J+1
2700 FORJ=NS+1TOLEN(L$):IFMID$(L$,J,1)<>CHR$(34)THENNEXT:PRINT"?SYNTAX ERROR":GOTO1440
2710 NE=J-1
2720 F$=MID$(L$,NS,NE-NS+1)
2730 FORJ=NE+2TOLEN(L$):IFMID$(L$,J,1)<>"-"THENNEXT:PRINT"?SYNTAX ERROR":GOTO1440
2740 T$=MID$(L$,NE+2,J-NE-2):GOSUB2200:D2=VAL(T$)
2750 T$=RIGHT$(L$,LEN(L$)-J):GOSUB2200:DE=VAL(T$)
2760 OPEN1,1,1,F$
2770 PRINT#1,D2:PRINT#1,DE:FORJ=D2TODE
2780 N1%=PEEK(J):PRINT#1,N1%:NEXT:CLOSE1:GOTO1440
2790 REM*** TAPE-MEM ***
2800 FORJ=6TOLEN(L$):IFMID$(L$,J,1)<>CHR$(34)THENNEXT:PRINT"?SYNTAX ERROR":GOTO1440
2810 NS=J+1
2820 FORJ=NS+1TOLEN(L$):IFMID$(L$,J,1)<>CHR$(34)THENNEXT:PRINT"?SYNTAX ERROR":GOTO1440
2830 NE=J-1
2840 F$=MID$(L$,NS,NE-NS+1)
2850 OPEN1,1,0,F$
2860 INPUT#1,D2:INPUT#1,DE
2870 FORJ=D2TODE:INPUT#1,N1%:POKEJ,N1%:NEXT:CLOSE1
2880 PRINT"*START ADDRESS";D2
2890 PRINT"*END ADDRESS";DE:GOTO1440
2900 REM*** MNEMONIC DATA ***
2910 DATABRK,ORA(X),,,,ORAZ,ASLZ,,PHP,ORA#,ASLA,,,ORA,ASL,,BPL
2920 DATAORA(Y),,,,ORAZX,ASLZX,,CLC,ORAY,,,,ORAX
2930 DATA ASLX,,JSR,AND(X),,,BITZ,ANDZ,ROLZ,,PLP,AND#,ROLA,,BIT,AND,ROL,,BMI
2940 DATAAND(Y),,,,ANDZX,ROLZX,,SEC,ANDY,,,,ANDX
2950 DATAROLX,,RTI,EOR(X),,,,EORZ,LSRZ,,PHA,EOR#,LSRA,,JMP
2960 DATAEOR,LSR,,BVC,EOR(Y),,,,EORZX,LSRZX,,CLI,EORY,,,,EORX
2970 DATALSRX,,RTS,ADC(X),,,,ADCZ,RORZ,,PLA,ADC#,RORA,,JMP(I)
2980 DATAADC,ROR,,BVS,ADC(Y),,,,ADCZX,RORZX,,SEI,ADCY,,,,ADCX
2990 DATARORX,,,STA(X),,,STYZ,STAZ,STXZ,,DEY,,TXA,,STY,STA
3000 DATASTX,,BCC,STA(Y),,,STYZX,STAZX,STXZY,,TYA,STAY,TXS,,,STAX,,,LDY#
3010 DATALDA(X),LDX#,,LDYZ,LDAZ,LDXZ,,TAY
3020 DATALDA#,TAX,,LDY,LDA,LDX,,BCS
3030 DATALDA(Y),,,LDYZX,LDAZX,LDXZY,,CLV,LDAY,TSX,,LDYX,LDAX,LDXY,,CPY#
3040 DATACMP(X),,,CPYZ,CMPZ,DECZ,,INY,CMP#,DEX,,CPY,CMP,DEC,,BNE
3050 DATACMP(Y),,,,CMPZX,DECZX,,CLD,CMPY,,,,CMPX,DECX,,CPX#
3060 DATASBC(X),,,CPXZ,SBCZ,INCZ,,INX,SBC#,NOP,,CPX,SBC,INC,,BEQ
3070 DATASBC(Y),,,,SBCZX,INCZX,,SED,SBCY,,,,SBCX,INCX
3080 REM*** BYTES DATA ***
3090 DATA1,2,2,2,1,2,1,3,3,2,2,2,2,1,3,3,3,3,2,2,2,2
3100 DATA1,2,1,3,3,3,2,2,2,2,1,3,1,3,1,2,2,2,1,2,1,3,3,3
3110 DATA2,2,2,2,1,3,3,3,1,2,2,2,1,2,1,2,3,3,2,2,2,2,1,3
3120 DATA3,3,2,2,2,2,1,1,3,3,3,2,2,2,2,2,2,1,2,1,3,2,2,2
3130 DATA2,2,2,1,2,1,3,3,3,2,2,2,2,2,1,3,1,3,3,3,2,2,2,2,2
3140 DATA1,2,1,3,3,3,2,2,2,2,1,3,3,3,2,2,2,2,2,1,2,1,3,3,3,2,2,2,2
3150 DATA1,3,3,3
READY.
```

SPECT DISASSEM

David Horne's ZX-81 disassembler prompted many readers to ask for a similar facility for their new Sinclairs. Now you can disassemble your Spectrum.

Figure 6. Pointer table REM 1.

```
23760
 60  28  28  29  39  41  29  36
 42  30  39  28  30  47  28  31
 47  28  29  47  49  21  28  28
 61  40  40  42  37  39  29  42
23791
 36  31  39  25  30  40  28  31
 48  28  29  48  49  22  28  28
 32  28  56  29  38  41  29  35
 42  30  30  28  30  45  28  31
23823
 45  28  29  45  49  23  28  28
 47  28  56  42  37  38  29  42
 35  31  38  28  30  46  28  31
 46  28  29  46  49  25  28  28
23855
 47  51  56  29  37  41  29  60
 37  30  37  28  30  43  28  31
 43  28  29  43  49  24  28  28
 47  52  56  42  37  37  29  37
23887
 60  31  37  28  30  44  28  31
 44  28  29  44  49  63  28  28
 47  53  55  29  52  41  29  60
 45  30  50  28  30  34  28  31
23919
 34  28  29  34  49  26  28  28
 47  54  56  42  37  59  29  42
 60  31  50  28  30  40  28  31
 42  28  29  42  49  27  28  28
23951
 29  47  47  29  47  48  29  47
 45  29  47  46  29  47  43  29
 47  44  29  47  34  29  47  42
 29  48  47  29  48  48  29  48
23983
 45  29  48  46  29  48  43  29
 48  44  29  48  34  29  48  42
 29  45  47  29  45  48  29  45
 46  29  45  46  29  45  43  29
24015
 45  44  29  45  34  29  45  42
 29  46  47  29  46  48  29  46
 45  29  46  46  29  46  43  29
 46  44  29  46  34  29  46  42
24047
 29  43  47  29  43  48  29  43
 45  29  43  46  29  43  43  29
 43  44  29  43  34  29  43  42
 29  44  47  29  44  48  29  44
24079
 45  29  44  46  29  44  43  29
 44  44  29  44  34  29  44  42
 29  34  47  29  34  48  29  34
 45  29  34  46  29  34  43  29
24111
 34  44  33  28  28  29  34  42
 29  42  47  29  42  48  29  42
 45  29  42  46  29  42  43  29
 42  44  29  42  34  29  42  42
24143
 42  42  47  42  42  48  42  42
 45  42  42  46  42  42  43  42
 42  44  42  42  34  42  42  43
 55  42  47  55  42  48  55  42
24175
 45  55  42  46  55  42  43  55
 42  44  55  42  34  55  42  42
 53  47  28  53  48  28  53  43
 28  53  46  28  53  43  28  53
24207
 44  28  53  34  28  53  42  28
 55  42  47  56  42  48  56  42
 45  56  42  46  56  42  43  56
 42  44  56  42  34  56  42  42
24239
 43  47  28  43  48  28  43  45
 28  43  46  28  43  43  28  43
 44  28  43  34  28  43  42  28
 54  47  28  54  48  28  54  45
24271
 28  54  46  28  54  43  28  54
 44  28  54  34  28  54  42  28
 46  47  28  46  46  28  46  45
 28  46  46  28  46  43  28  46
24303
 44  28  46  34  28  46  42  28
 45  47  28  45  46  28  45  45
 28  45  46  28  45  43  28  45
 44  28  45  34  28  45  42  28
24335
 51  51  28  49  39  28  46  51
 41  46  28  41  44  51  41  50
 39  28  42  42  49  34  28  28
 51  28  52  51  28  28  46  52
24367
 41  28  30  28  44  52  41  44
 28  41  55  48  49  35  28  35
 51  53  28  49  38  28  46  53
 41  58  49  42  44  53  41  50
24399
 38  28  53  28  49  36  28  28
 51  54  28  59  28  28  46  54
 41  57  42  49  44  54  41  28
 31  28  52  42  49  37  28  28
24431
 51  55  28  49  37  28  46  55
 41  61  59  37  44  55  41  50
 37  26  43  49  28  38  28  28
 51  61  28  46  34  28  46  61
24463
 41  59  38  37  44  61  41  28
 32  28  54  49  28  39  28  28
 51  57  28  49  40  28  46  57
 41  28  28  28  44  57  41  50
24495
 40  28  48  49  28  40  28  28
 51  58  28  29  50  37  46  58
 41  62  28  28  44  56  41  28
 31  28  45  49  28  41  28  28
```

Sinclair character	Address content	Address	Z-80 mnemonic
NEXT	243	0	DI
CODE	175	1	XOR A
	17	2	LD DE 65535
COPY	255	3	
COPY	255	4	
NOT	195	5	JP 4555
THEN	203	6	
	17	7	
*	42	8	LD HL (23645)
]	93	9	
\	92	10	
"	34	11	LD (23647) HL
_	95	12	
\	92	13	
	24	14	JR 67
C	67	15	
NOT	195	16	JP 5618
PAUSE	242	17	
	21	18	
COPY	255	19	RS56
COPY	255	20	RS56
COPY	255	21	RS56

Figure 1.

THIS SPECTRUM disassembler is based on the ZX-81 disassembler that appeared in the July issue of *Your Computer*. The method used for creating the long Rem statement is repeated and the use of tables to point to commands is also retained. I know from your letters that many of you have already successfully produced a Spectrum disassembler from the original article, but for those who did not, here is how to do it.

Bytes table Rem 4
Number of parts to Z-80 op code

CB	IX IY		ED
All ones	All ones except		All ones
	034	3	
	052	2	
	053	2	
	054	3	
	070	2	
	078	2	
	086	2	
	094	2	
	102	2	
	110	2	
	112	2	
	113	2	
	114	2	
	115	2	
	116	2	
	117	2	
	119	2	
	126	2	
	134	2	
	142	2	
	150	2	
	158	2	
	166	2	
	174	2	
	182	2	
	190	2	
	203	3	

The above takes into account the important Z-80 op codes to these parameters.

Figure 8.

We use three tables to decode the machine-code listings. The first table in Rem 1 points to the mnemonics of the assembly language in Rem 2 and Rem 3. Figure 1 shows a typical output and figure 2 shows how the output was achieved. The first character of Rem 1 points to the command table Rem 2 and the second and third characters point to the extension table Rem 3.

The initial problem is to produce the first Rem which contains 768 bytes. Create Rem 1 with 100 characters — see figure 3. Edit the line number to create REMs 2 to 7 inclusive. Then type Rem 8 with 26 characters. It helps if you Poke 23609, 255 first.

8 REM 123 . . . 3 4 5 6 (26 characters)

Save the code produced so far by Save "1". To check, type

PRINT PEEK 24528

This should give the answer 13. Type in the following for one long Rem statement

```
POKE 23757, 2
POKE 23758, 3
```

Then type

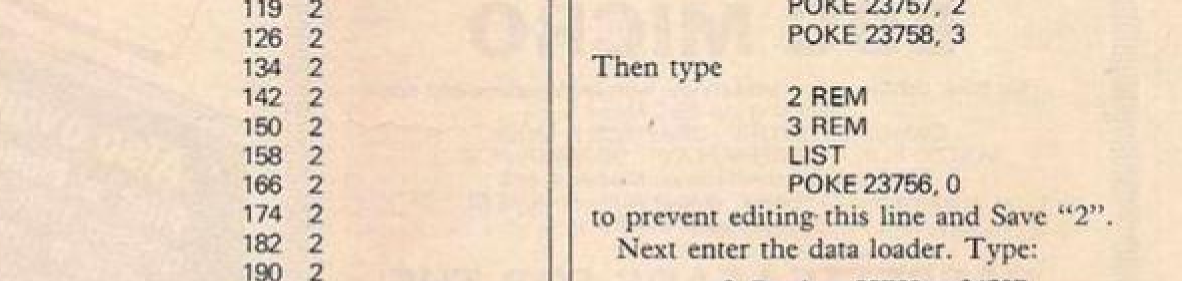
```
2 REM
3 REM
LIST
POKE 23756, 0
```

to prevent editing this line and Save "2".

Next enter the data loader. Type:

```
2 For A = 23760 to 24527
3 Input B
4 Poke A, B
5 PRINT A ; TAB 8 ; B
6 NEXT A
```

Figure 2. Table operation.



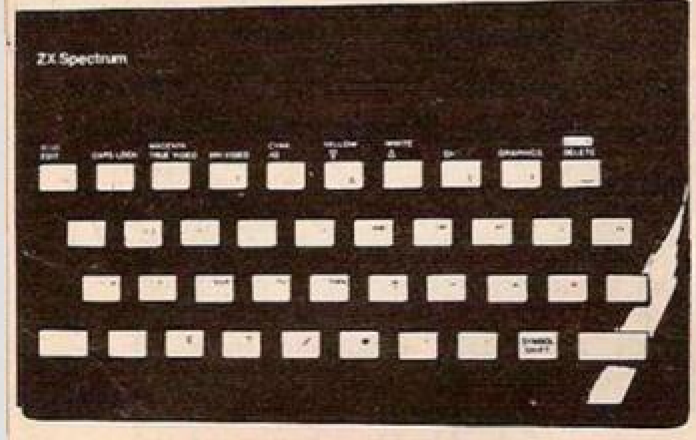
Taking 1 REM

(1) 29 39 41 = LD BC NN
(2) 29 36 42 = LD bc A
(3) 30 39 28 = INC BC
(4) 30 47 28 = INC B
(5) 31 47 28 = DEC B

check these on page 183 of your Sinclair manual.

RUM

ABLER



Carefully enter the data into the Rem statement by typing Run. Make a note of any errors you make and go over them later on by Poking the correct value.

The list is given in figure 6, but unfortunately only a small portion will be seen on the screen if the Rem is listed. When you have entered all the data, delete lines 3 and 4 and check by typing Run. Then Save "4".

Figure 9.

EXTENSION TABLE REM 3

1		21
2		22
3	cb	23
4	ix	24
5	ed	25
6	iy	26
7	hl	27
8	de	28
9	bc	29
10	HL	30
11	DE	31
12	BC	32
13	AF	33
14	NN	34
15	A	35
16	H	36
17	L	37
18	D	38
19	E	39
20	B	40
21	C	41
22	N	42
23	SP	43
24	NZ	44
25	Z	45
26	NC	46
27	C	47
28	PO	48
29	DS	49
30	+	50
31	-	51
32	sp	52
33	nn	53
34	PE	54

Blocks of two

Figure 3.

```
   1 REM 1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Enter Rems 2, 3 and 4 as you would a normal Rem statement. The spaces are important, see figures 6, 7, 8 and 9. The following will check whether your tables are correct.

Print PEEK 23760 should give 60.

Print PEEK 24534 should give 82. If not, table 1 is wrong.

Figure 7.

COMMAND TABLE REM 2

1	RICA	21
2	RRCA	22
3	RIA	23
4	DAA	24
5	RRA	25
6	SCF	26
7	CCF	27
8	DI	28
9	LD	29
10	INC	30
11	DEC	31
12	DJNZ	32
13	HALT	33
14	RST0	34
15	RST8	35
16	RS16	36
17	RS24	37
18	RS32	38
19	RS40	39
20	RS48	40
21	RS56	41
22	ADD	42
23	AND	43
24	CALL	44
25	CP	45
26	JP	46
27	JR	47
28	OR	48
29	POP	49
30	PUSH	50
31	RET	51
32	SBC	52
33	SUB	53
34	XOR	54
35	ADC	55
36	SBC	56
37	IN	57
38	OUT	58
39	EXX	59
40	NOP	60
41	EX	61
42	EI	62
43	CPL	63

Blocks of four

Print PEEK 24716 should give 99. If not, table 2 is wrong — check space after CPL.

Print PEEK 24786 should give 48. If not, table 3 is wrong.

When all is correct, delete line 5 and enter the program in figure 4. I have included a copy facility which can be substituted if you do not have a printer. Type

163 PAUSE 150

Figure 5.

Basic listing

```
   6 LET G=24786
   7 LET A=23760
   8 LET N=24534
   9 LET P=24712
  10 LET C=20
  11 LET D=C/C
  12 LET E=D+D
  13 GO TO 150
  14 GO SUB 140
  15 LET I=A+3*PEEK J
  16 LET K=PEEK I
  17 LET L=PEEK (I+D)
  18 LET M=PEEK (I+E)
  19 LET F=J
  20 IF L=C+E+D THEN GO TO 90
  21 IF L=C+E+E THEN GO TO E*C-D
  22 IF L=C+E THEN GO TO 50
  24 LET I=N+((K-21)*E*E)
  25 PRINT CHR$ PEEK I;CHR$ PEEK
(I+D);CHR$ PEEK (I+E);CHR$ PEEK
(I+D+E);" ";
  26 IF L=49 THEN GO TO 42
  27 IF L=60 THEN GO TO C+C+C
  29 LET I=P+((L-C)*E)
  30 GO SUB 80
  31 IF M=49 THEN GO TO 63
  32 IF M=41 THEN GO TO 67
  33 IF M=60 THEN GO TO 71
  34 IF M=C+C THEN GO TO G-P
  36 LET I=P+((M-C)*E)
  37 GO SUB 80
  38 PRINT
  40 IF J>F THEN GO TO G+C-P
  41 GO TO 160
  42 PRINT PEEK (J+D);" ";
  43 LET J=J+D
  44 GO TO 36
  46 PRINT "(";PEEK (J+D)+256*PE
EK (J+E);")";
  47 LET J=J+E
  48 RETURN
  50 LET J=J+D
  51 GO TO C
  55 LET B=D
  56 FOR I=D-D TO C+C STEP 8
  57 IF PEEK (J+D)=67+I THEN LET
 B=D+E
  58 NEXT I
  59 LET J=J+B
  60 GO TO C
  63 PRINT PEEK (J+D);
  64 LET J=J+D
  65 GO TO 36
  67 PRINT PEEK (J+D)+256*PEEK (
J+E);
  68 LET J=J+E
  69 GO TO 36
  71 GO SUB 46
  72 GO TO 38
  74 IF PEEK (J+D)>128 THEN GO T
O 77
  75 PRINT PEEK (J+D);
  76 GO TO 64
  77 PRINT (PEEK (J+D))-256;
  78 GO TO 64
  80 PRINT CHR$ PEEK I;CHR$ PEEK
(I+D);" ";
  81 RETURN
  84 GO SUB G-P-C
  85 GO TO C+D+E
  90 LET B=D
  91 FOR H=G TO G+108 STEP E+E
  92 IF PEEK (J+D)=((PEEK H)-C)
*100+(PEEK (H+D)-C)*10+(PEEK (H+
E)-C)) THEN LET B=PEEK (H+D+E)-C
  93 NEXT H
  94 GO TO 59
 102 GO SUB 120
 103 LET F=F+D
 104 GO TO 39
 120 IF PEEK (F+D)<30 THEN GO TO
124
 121 PRINT CHR$ PEEK (F+D);TAB 8
;PEEK (F+D);TAB 12;F+D
 122 RETURN
 124 PRINT TAB 8;PEEK (F+D);TAB
12;F+D
 125 RETURN
 140 IF PEEK J<30 THEN GO TO 144
 141 PRINT CHR$ PEEK J;TAB 8;PEE
K J;TAB 12;J;TAB 17;
 142 RETURN
 144 PRINT TAB 8;PEEK J;TAB 12;J
;TAB 17;
 145 RETURN
 150 FOR S=0 TO 23760 STEP 19
 151 FOR J=S TO S+18
 152 GO TO 14
 160 NEXT J
 161 COPY
 163 CLS
 164 NEXT S
 165 STOP
```

Explanation

Line	Explanation	
6 LET G=24786	ED CB IX IY table start	G
7 LET A=23760	Pointer table start	A
8 LET N=24534	Command table start	N
9 LET P=24712	Extension table start	P
16 LET K=PEEK I	1st) Item in	K
17 LET L=PEEK (I+D)	2nd) pointer table	L
18 LET M=PEEK (I+E)	3rd)	M
25	Print command	
90 LET B=D	DD FD routine	
150 FOR S=0 TO 23760 STEP 19	Routine to page results.	

Figure 4.

Tables	Function
`0>REM (???')?$*?'??/??/??/1`	Pointer table blocks of three
`2 REM RICARRCARIA DAA RRA SCF CCF  DI  LD INC DEC DJNZHALTRST0RST8RS16RS24RS32RS40RS48RS56ADD AND CALL CP  JP  JR  OR POP PUSHRET SBC SUB XOR ADC SBC  IN OUT EXX NOP  EX  EI CPL`	Command table blocks of four
`3 REM      cbixediyhldebcHLDEBCAFNNA H L D E B C N SPNZZ NCC PDD5+ - spnnPE`	Extension table blocks of two
`4 REM 0343052205320543070207820862094210221102112211321142115211621172119212621342142215021582166217421822190220 33`	ED, CB, IX, IY table blocks of four

FLUEN

In the last part of this series, Tony Edwards explains the use of flowcharts in computer-language translation.

WHERE THE DIALECT of Basic to be translated is so alien to the one your machine uses, the kind of direct translation discussed in the previous articles in this series is difficult or impossible to apply. This is, of course, also applicable to translations from one language to another.

The method I shall use is to revert to flowcharting — that basic step in programming which we all know is essential, but which we usually manage to do without.

Our regular readers will have seen a form of flowchart in this magazine each month. It is heavily disguised as a puzzle and will be found in *Your Computer's* Competition Corner.

The type of flowchart we will use is more stylised so that it can be more readily transformed into Basic, your dialect of the language. Once you have mastered the art, you should be able to change the Competition Corner puzzle into a stylised flowchart and then into Basic so your computer can solve it for you.

A flowchart is a number of symbols joined up by usually one-way paths. Different programmers use different symbols, but so long as they are consistent within a chart that does not matter. The symbols I use are shown in figure 1.

The start, stop, go to and from symbols are self-evident. The input and output symbols are graphic: they represent an input card and a roll of used copy output. The assignment statement box is to contain a list of statements assigning values to variables or altering the value of variables.

These statements must be in a set order and contain no branching or double flows. They are just a series of operations to be undertaken in order. Branching takes place in the decision boxes. These contain a simple statement which can be answered "yes" or "no" and the path leading from the box is chosen dependent on the answer.

Only decision boxes have two paths away, but any type of box could have multiple paths leading to it. The cardinal rule is that at each part of the diagram there is only one path to take.

Let us produce a flowchart to play the game of noughts and crosses. My suggestion is shown in figure 2. If you prefer another one it does not matter. Provided there is only one path from each part of the diagram, all flowcharts are equally valid and there are numerous ways of arranging this game.

Check through this flowchart to see that it complies with the rules I have just set out. It is usual to number at least some of the boxes so that they can be referred to, but the sequence of these numbers has no significance.

The next step is to enlarge the boxes maintaining the structure of the diagram so that it adheres to the rules of your programming language. If you are not familiar with flowcharting, it is worth working through the whole chart to produce the Basic code for the game. Here I shall content myself with the boxes 1, 6 and 9.

I have decided to set up an array for the game board and will call it A(9). If your dialect does not have arrays use the variables A1 to A9. Figure 3 is the next stage of the flowchart and figure 4 is the final stage which is practically the code for the program. Work through these to see the logical connections. You will see that box 1 has been split into boxes 1.1 and 1.2 and the others likewise.

The final step is to write out the code with the correct Gotos and to clean it up. Eagle-eyed programmers will see that I have jumped out of a For-Next loop in 6.1 and 9.1, but my method of making this possible is in a previous article or you could use the methods shown in the listing of program 1.

```
10 DIM A(9) : DEFINT A-Z : RANDOM
20 R! = RND(0)
30 IF R! >0.5 THEN 100
40 (input players move)
 .
 .
 .
100 FOR I = 1 TO 9
110 IF A(I) <> 0 THEN 110
120 A = I:I = 10
130 NEXT I
140 A(A) = 1 : B = 0
150 FOR I = 1 to 9
160 IF A(I) = 0 THEN B = 1
170 NEXT I
180 IF B = 1 THEN 40 ELSE (game drawn)
```

Program 1.

```
1000 IF A <10 AND IF B <0 THEN Z = 0
     ELSE Z = 1
1010 IF C < 100 AND IF Z = 0 THEN C = C
     — 100 ELSE Z = 1
1020 IF Z = 0 GOSUB 2000 ELSE GOSUB
     3000
1030 ON D GOSUB 100, 200, 400, 400
```

Program 2.

```
10 IF A < 10 THEN 30
20 IF B < 0 THEN 40
30 Z = 1 : GOTO 50
40 Z = 0
50 IF C < 100 THEN 70
60 Z = 1 : GOTO 120
70 IF Z = 0 THEN 90
80 GOTO 120
90 C = C — 100
100 GOSUB 2000
110 GOTO 130
120 GOSUB 300
130 IF D = 1 THEN 100
140 IF D = 2 THEN 200
150 GOTO 400
```

Program 3.

```
(*DICE THROW*)
VAR LINE : INTEGER ;
PROC RANDOM ;
    VAR M, N, P: INTEGER;
    BEGIN
    REPEAT
      M := N*125
      IF M<0 THEN
          M := ABS(M)
      N := M ; P := M
      P := P MOD 7 ;
    UNTIL P <> 0
    WRITE (P# )
END ;
BEGIN
WRITE (28, 31, 220, 'DICE') ;
FOR LINE := 1 TO 8 DO
    WRITE (13, 220)
N := 99
RANDOM
WRITE (32, 32)
RANDOM
END
```

Program 4.

```
10 N = 99 : REM SEED FOR RANDOM
   NOS
20 GOSUB 1000
 .
 .
 .
1000 REM SUBROUTINE FOR RANDOM
     DICE THROW
1010 M = N * 125
1020 IF M < 0 THEN M = M * —1
1030 N = M
1040 P = M
1050 P = P — INT (P/7) * 7
1060 IF P = 0 THEN 1010
1070 PRINT P
1080 RETURN
```

Program 5.

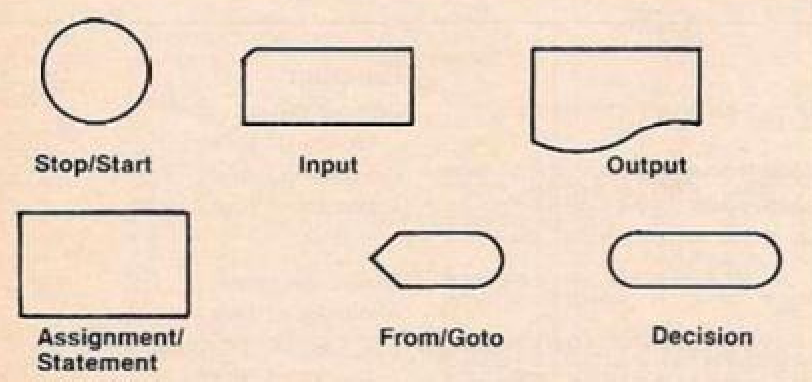


Figure 1.

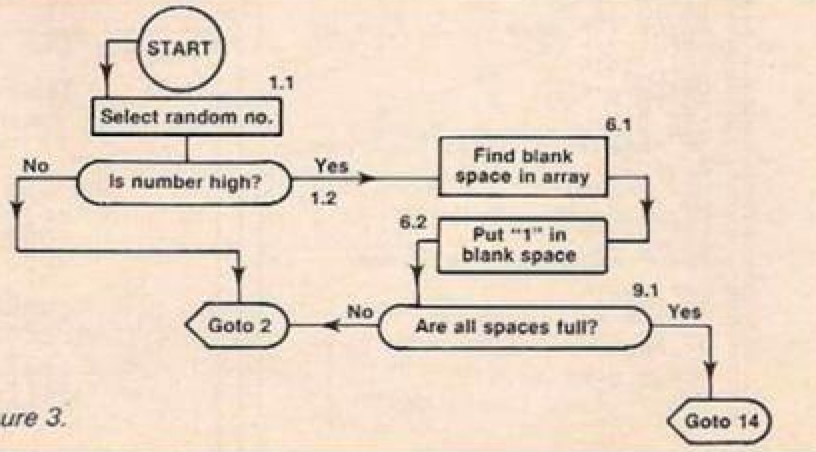


Figure 3.

NT BASIC

When then is this flowcharting to do with translation? Logic is two-way so that it is possible to change a language code back to a flowchart. Thus when faced with a piece of untranslatable code you should convert it into a flowchart then reconvert it into your dialect.

First a simple example. Program 2 is a small part of a complex program listing. If you do not have If-Then-Else and On-Go To statements in your Basic dialect you could have considerable trouble with the translation. However, it is easily converted to the flowchart at figure 5, and then to the listing in your dialect — for example, program 3.

It is listings like this which give Basic a bad name as an unstructured language, but at least with the help of a flowchart you can keep control of the logic, and can in many cases, including this one, improve on the flow of the program at the flowchart level before encoding it in Basic.

Now for a more complex example. If the program you wish to translate is not in Basic, but in some other language it is not usually possible to translate directly as different programming languages have different structures. Nevertheless they are all developed, at least theoretically, from common flow diagrams.

Thus if we can convert the "foreign" language to a suitable flow diagram we can then convert the flow diagram to Basic. So let us try.

Program 4 is in the language Pascal. It is a program to simulate a dice throw. In this case it would be reasonable to reprogram it in Basic from scratch, but by way of an illustration we will flowchart it. Even if you do not know the language, or know it only slightly, it is usually possible to develop a suitable flowchart especially if you know what the program is intended to do. My flowchart from program 4 is at figure 6. Can you see the correspondence between the two?

For those readers not familiar with the basics of Pascal some explanation is in order. The Proc or procedure in Pascal is similar to a subroutine. In this simple example it is only necessary to flowchart the Proc as the rest of the program is just house-keeping, screen clearing Tabbing, and so on. The symbol :=, unfamiliar to Basic users, is the assignment statement and can be read as "becomes". For example, A := B means A becomes B. This is similar to a = in Basic. The rest of the Proc is reasonably simple to follow.

Having arranged the flowchart we can forget its Pascal origins and transform it into Basic statements. I have resisted the temptation to simply replace it with

```
10 P = RND(5) + 1 : ? P
```

as this would not help you understand the technique. The flow diagram is simply a method of generating pseudo-random numbers using modular arithmetic and is encoded into Basic without difficulty — see program 5.

The only problem is with the box 4 statement P = P(Mod 7), which is a standard, if obscure, mathematical expression meaning P is the remainder when P is divided by 7. For example, if P originally was 22 then P(Mod 7) would be 1 as P ÷ 7 = 3 remainder 1. ■

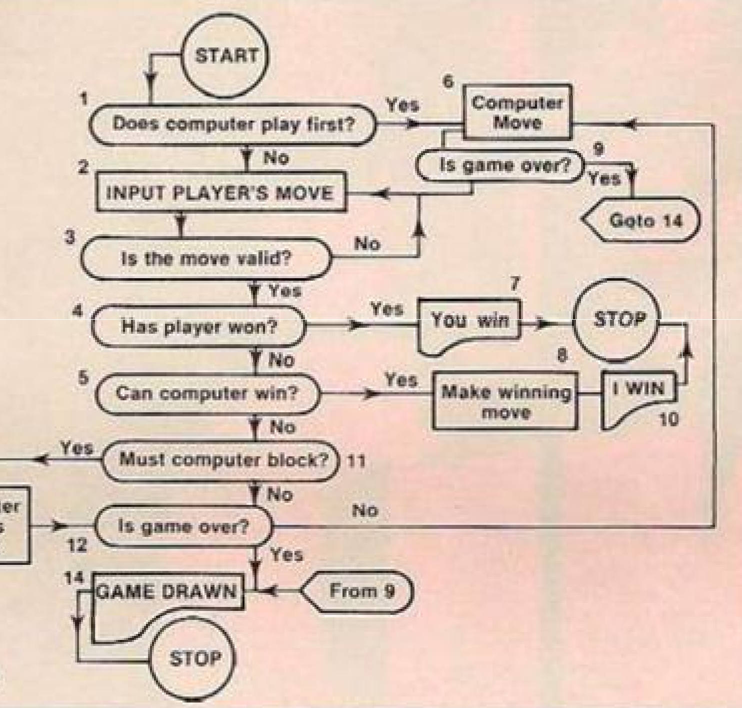


Figure 2.

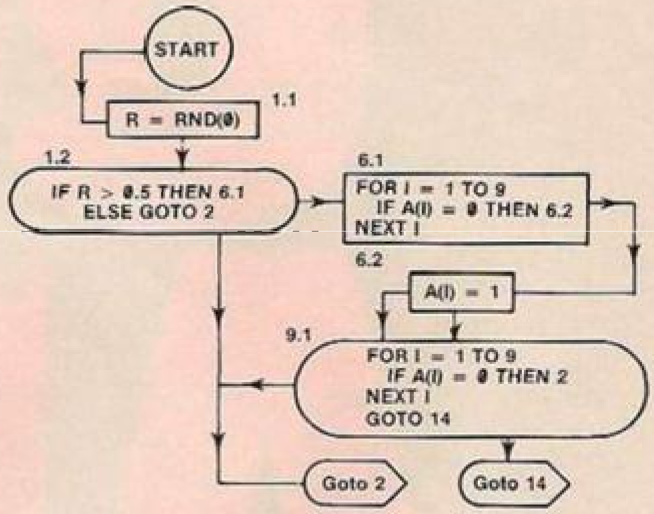


Figure 4.

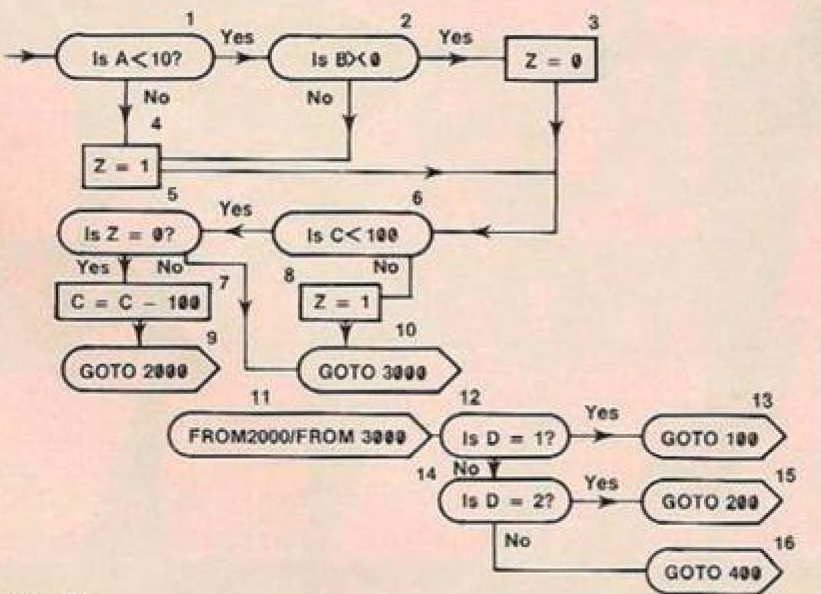


Figure 5.

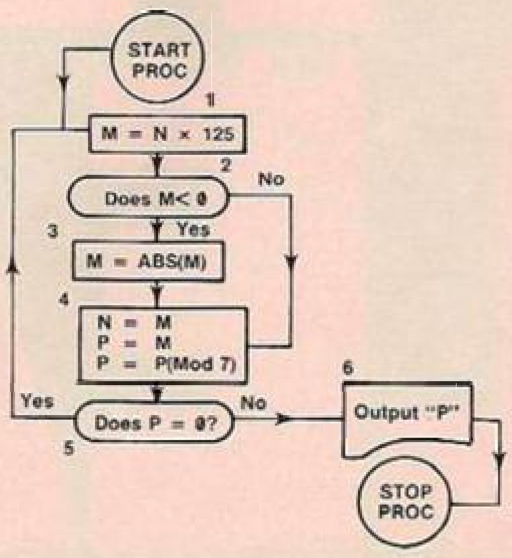


Figure 6.

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ZX-81

COMPILING AN index is, at best, a long and rather tedious job. If funds do not run to a professional indexer, the author has to do the job himself. Traditionally, indexes are compiled on cards, which are sorted into order — just the kind of job which could be done easily on a computer.

The Indexer program was written to help me compile a short index for a book but could, of course, be used equally well for an index of records, tapes, or whatever you like.

Inevitably, the ZX-81's 16K memory places some limitations on what can be done. A balance must be struck between the facilities the program offers and the amount of space it leaves for the index entries. I ended up with a program of slightly more than 6K, including system variables and display file, leaving about 10K for the index itself. The way the program is designed allows a maximum of 340 index entries — enough for a large record collection, or for the index of an average textbook.

Using the program

Rather than describe in detail the way the program is constructed, I will begin by giving a set of instructions for using the Indexer. The program is intended to be as user-friendly as possible, and having used a number of expensive commercial software packages, I think it is as good as most. The use of Inkey$ for commands justifies, I am sure, the small amount of extra memory used, compared with Input — which requires two key pushes instead of one.

Similarly, the program is difficult to crash, and rejects most kinds of incorrect entry. At least I have not yet found anything that can lead to loss of data. Finally, before the operator instructions, I should mention that I use a typewriter keyboard for the ZX-81, and Fast mode. This enables you to type at almost normal speed.

First, load the program from the tape under the name

"INDEXER"

The program will start with the menu. Select option 1 from the menu to start:

1 BEGIN NEW INDEX

This clears all previous data and selects entry mode for the index. The screen will show a heading marked "Entry" and "Page", and a number, 0, in the top-left corner.

Entries can be typed into the Indexer in random order. No entry can be longer than 27 characters, and no page number larger than 999. The maximum number of entries is 340.

Type in the entry, followed by Newline, then the page number, followed by Newline. The counter at the top-left will record the total number of entries. The program will automatically reject any entry that is empty, and any page number larger than three digits or starting with a non-numeric character. To delete incorrect entries before pressing Newline, use Rubout in the usual way. After Newline has been pressed you must use the Edit Index facility.

To return to the menu, key 0 as if it were an entry, not a page number. Note that entry mode returns to the menu via a sort routine that may take several minutes, depending on the number of entries.

2 KEY ENTRIES

This works in the same way as option 1 Begin New Index, except that existing data is not deleted. This enables you to continue adding to the index after saving and loading the existing entries. The counter records the total number of entries.

3 SAVE ENTRIES

Option 3 allows you to save the program and data on tape. Save time will vary according to the contents of the index, but you should always allow at least 10 minutes' worth of tape for saving.

The Indexer and contents is loaded from the tape with a Load "Indexer" command.

4 PRINT INDEX

Option 4 prints out the index on the screen or printer, merging identical entries and listing page numbers in numerical order. The index is printed out in strict alphabetical order, regardless of the order in which entries were keyed.

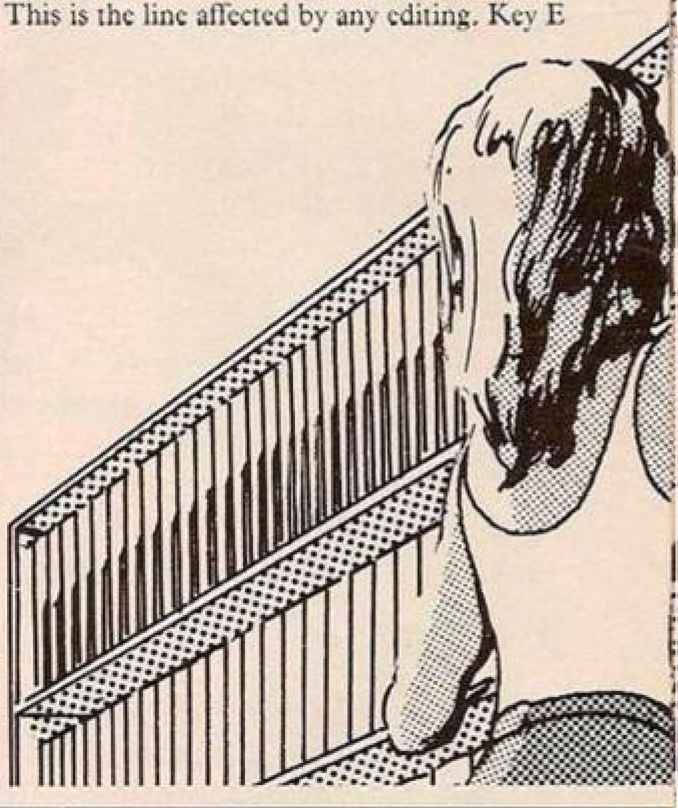
You are given the option to print on the screen or printer. When printing on the screen, the index is printed from the beginning in screen-sized blocks. Pressing any key moves on to the next block. When the last block is reached, an End message is displayed at the top of the screen; the next key push returns to the menu — it may take a few seconds for the menu to reappear. During printing, the computer operates in fast mode for just over half a minute between screens.

If the printer option is selected the screen is not used. The printer prints out the index in blocks; computing time between blocks is just over half a minute. When the printing is finished, the screen displays the last block of the index and the End message. Any key returns to the menu after a short delay.

5 EDIT INDEX

Option 5 provides an editing facility. The index is listed, unmerged, on the screen. Cursor controls can be used to step through the index — the keys, without shift, can be held down for continuous stepping. The down-cursor control moves down the index eight lines at a time for rapid stepping through the index; the up cursor moves up one line at a time.

The lowest entry on the screen is highlighted with a cursor or inverse first character. This is the line affected by any editing. Key E



```
  0 REM (C) JOHN WATSON,1982
  1 DIM A$(341,30)
  2 LET CT=0
  3 GOTO 100
 10 LET X=325-CT
 12 LET CD=0
 13 FAST
 16 CLS
 17 FOR N=1 TO 17
 20 PRINT A$(X)
 25 LET X=X+1
 30 NEXT N
 35 LET X=X-1
 40 PRINT AT 16,0;CHR$ ((CODE A
$(X))+128)
 46 PRINT AT 20,0;"0=MENU, E=ED
IT, D=DELETE OR    CURSOR UP OR
 DOWN TO VIEW PAGES."
 47 SLOW
 50 GOTO 550
100 CLS
105 SLOW
110 PRINT "            INDEXER"
120 PRINT
125 PRINT "1  BEGIN NEW INDEX"
130 PRINT
135 PRINT "2  KEY ENTRIES"
140 PRINT
155 PRINT "3  SAVE ENTRIES"
160 PRINT
165 PRINT "4  PRINT INDEX"
170 PRINT
175 PRINT "5  EDIT INDEX"
180 LET K$=INKEY$
190 IF K$="1" THEN GOTO 230
195 IF K$="2" THEN GOTO 496
205 IF K$="3" THEN GOTO 8500
210 IF K$="4" THEN GOTO 1990
215 IF K$="5" THEN GOTO 10
220 GOTO 180
230 CLS
235 PRINT AT 11,0;"WARNING THIS
 DELETES ALL DATA.  KEY Y TO GO
ON, 0 FOR MENU."
240 IF INKEY$="Y" THEN GOTO 485
245 IF INKEY$="0" THEN GOTO 100
250 GOTO 240
485 CLEAR
486 DIM A$(341,30)
490 LET CT=0
```

INDEXER

John Watson's Basic program for the ZX-81 means you can compile an index for your library of books or for your record and cassette collection.



for edit. The whole line can then be re-entered, as in entry mode. The line will appear correctly when either cursor control is moved.

Key D for delete, having made sure that cursor is at the line to be deleted. Note that you cannot fll the gap left by a deleted line while in edit mode: to insert new entries you need to go to option 2 Key Entries from the menu. Again, to return to the menu key 0. Remember that Edit mode also returns to the menu via what can be a lengthy sort.

In case of an accident, like keying Break by mistake, the program can be restarted by Goto 100. The printed index has gaps between each block of 10 lines or so; this is intentional, and improves legibility if the index is to be retyped.

It is not a good idea to enter all 340 entries unless you have to — after 340, the program leaves entry mode, and goes back to the menu, but with an unsorted list. To make it sort, go to Edit mode, option 5, then immediately key 0 to go back to the menu again through the sort routine.

How it operates

Here is how the program works. The index entries are stored in a string array, which is dimensioned as A$(341,30). The last entry is not used, but is necessary for the program operation. CT counts the number of entries. The main menu is at lines 105 to 220.

Keying 1 goes first to a "do you really mean it?" message at 230 to 250, then redimensions the array, deleting all data. It then goes into the main key entries routine at 496. This prints the heading and the current entry number, and warns when the index is nearly full. When the index is filled right up, the program returns to the menu — this is more helpful than going through the sort routine in the usual way, as it provides some idea of what has happened. Unexpectedly launching into the sort routine, with its several minutes' worth of blank screen, can make you think the program has crashed.

Line 520 goes to the entry-checking subroutine at 5010. The index entry C$ is checked for an empty string, a blank first character, or for 0 which is the "leave entry mode" command. The page number B$ is

(continued on next page)

```
 496 FAST
 497 CLS
 498 LET X=1
 500 PRINT AT 0,0;"      *******EN
TRY********** PAGE";AT 0,0;CT
 505 IF CT>330 THEN PRINT AT 0,4
;"INDEX ALMOST FULL"
 510 IF CT>340 THEN GOTO 100
 520 GOSUB 5010
 530 SCROLL
 540 GOTO 500
 550 LET K$=INKEY$
 555 IF K$="7" THEN GOTO 600
 560 IF K$="6" THEN GOTO 620
 565 IF K$="0" THEN GOTO 680
 570 IF K$="E" THEN GOTO 700
 575 IF K$="D" THEN GOTO 650
 580 GOTO 550
 600 LET X=X-17
 605 IF X<326-CT THEN LET X=325-
CT
 610 GOTO 13
 620 LET X=X-8
 630 IF X>324 THEN LET X=324
 635 GOTO 13
 650 IF A$(X,1)=" " THEN GOTO 55
0
 652 LET A$(X)=""
 655 LET CD=CD+1
 660 GOTO 600
 680 LET CT=CT-CD
 690 GOTO 8000
 700 IF A$(X,1)=" " THEN GOTO 55
0
 705 LET CT=CT-1
 710 GOSUB 5010
 720 GOTO 550
1990 PRINT AT 20,0;"PRINTER (P)
OR SCREEN (S)?"
1994 LET P$=""
1995 LET P$=INKEY$
1996 IF P$="P" OR P$="S" THEN GO
TO 2000
1997 GOTO 1995
2000 LET X=341-CT
2005 FAST
2006 CLS
2010 IF PEEK ((PEEK 16396+256*PE
EK 16397)+67)<>0 THEN GOTO 2200
2020 SCROLL
```

(listing continued on next page)

(continued from previous page)
checked to see if it is empty, or if it starts with a non-numerical character. It did not seem worth checking all three figures, as this is not a mistake likely to be made during entry — forgetting to put in the page number is a possibility, but putting in an alpha-numeric page number seemed far-fetched. Anyway, you can pick it up during editing.

Lines 5070 to 5090 are interesting, as they range the page number to the right-hand end of the string holding the entry. The number is always held at the extreme end of the string so that it is sorted properly. Without ranging right, page 150 would be sorted before page 35.

Entry is always followed by a sort — at lines 8000 to 8260. Regular readers will recognise the excellent Shell-Metzner sort routine by David Lawrence, published in the April 1982 edition of *Your Computer*. Why rewrite a good program?

Option 5 on the menu, edit index, takes us to line 10 which prints out the index on the screen, and waits for a command from a secondary menu at 46 to 50 and 550 to 580. Line 40 prints the first letter of the entry affected by edit, in inverse. Up and down cursor controls work through the index, 0 goes back to the menu, and D deletes an entry, not forgetting to make the necessary correction to the entry counter, line 655.

Note that all the entries end up in the array in reverse order after sorting; CD is used to store the number that has to be subtracted from the total counter after editing is finished. The next sort — automatically after editing, line 690 — gets rid of the empty strings. Note line 650, which prevents re-deletion of deleted strings — this would upset the entry counting.

Option 4, print index, also includes the merging routine. The entries are merged only during printout, so that they are available for editing separately if required later. Since entries are printed from the bottom of the screen and moved up with scroll to place them in the correct order, there has to be some way of checking when a screenful has been supplied.

This is done by line 2010 which Peeks the second line of the display file to see if there is anything there. If there is, then the program either waits for a key push, line 2210, or Copies the screen, according to whether screen or ZX printer has been selected. The actual printing and merging takes place from line 2040.

Line 2040 prints out the entry, and if the string is empty — that is, it is the one after the last-used string — goes on to the winding up routines at 2260 which scrolls the entries up to the top of the screen to avoid an odd gap when the last part of the index is printed out.

If the string is not empty, the entry part is stored in Z$ and is compared with the same part of the next entry, line 2100, and just the number, preceded by a comma, from the next string is printed — line 2160 — if the next entry is identical. The subroutine at 3000 finds the print position for the page numbers, which should be just after the entry and not at the far end of the line.

Note that there are two Saves at the end of the listing. The one at 8600 should be used when you save the master copy of the program, with Clear and then Goto 8600. This saves the program without the string array — Save/Load time is about two minutes. The other Save routine, from 8500 to 8530, is used from the menu to save the program with the array, which takes far longer. If you do not know the "line 0" trick, do not bother entering the first Rem statement in the listing.

There is certainly room for improvement and the program is a good example of Basic spaghetti. It typifies the program that has been put together piecemeal, but on the other hand, it would have taken me far longer to write in any other language, because several points occurred to me during, rather than before, writing. Also, it badly needs a Renumber.

Obviously, owners of bumper-size RAM packs can store more entries. Each entry takes 30 bytes. To change the size of the array, you will need to alter lines 1, 10, 486, 505, 510, 605, 630, 2000, 2135, and 8040.

(listing continued from previous page)

```
2030 SCROLL
2040 LET Z$=A$(X, TO 27)
2045 IF Z$(1)=" " THEN GOTO 2260
2050 PRINT AT 19,0;Z$
2060 LET X=X+1
2070 LET Y$=A$(X, TO 27)
2080 GOSUB 3000
2090 PRINT AT 19,C;", ";A$(X-1,2
8 TO 30);
2095 LET C=C+5
2100 IF Y$<>Z$ THEN GOTO 2010
2110 GOTO 2160
2120 LET Z$=Y$
2130 LET X=X+1
2135 IF X>341 THEN GOTO 2260
2140 LET Y$=A$(X,1 TO 27)
2150 IF Y$<>Z$ THEN GOTO 2010
2160 PRINT ",";A$(X,28 TO 30);
2165 LET C=C+4
2166 IF C>28 THEN GOSUB 2500
2170 GOTO 2120
2200 IF P$="P" THEN GOTO 2240
2205 PRINT AT 0,0;"          PRESS ANY
 KEY TO CONTINUE    "
2210 PAUSE 33000
2215 CLS
2220 GOTO 2010
2240 COPY
2245 CLS
2250 GOTO 2010
2260 IF PEEK ((PEEK 16396+256*PE
EK 16397)+67)<>0 THEN GOTO 2300
2270 SCROLL
2280 GOTO 2260
2300 IF P$="P" THEN COPY
2310 PRINT AT 0,0;"END"
2320 PAUSE 33000
2330 GOTO 100
2500 SCROLL
2510 PRINT AT 19,0;
2520 LET C=0
2530 RETURN
3000 LET C=27
3010 IF A$(X-1,C)<>" " THEN RETU
RN
3020 LET C=C-1
3030 IF C<1 THEN RETURN
3040 GOTO 3010
3050 GOTO 100
5010 INPUT C$
5020 IF C$="0" THEN GOTO 8000
5025 IF C$="" THEN GOTO 5010
5030 IF C$(1)=" " THEN GOTO 5010
5035 LET A$(X)=C$
5036 LET CT=CT+1
5040 PRINT AT 19,0;A$(X, TO 27);
", ";
5050 INPUT B$
5055 IF B$="" OR LEN B$>3 THEN G
OTO 5050
5060 IF B$(1)>"9" OR B$(1)<"0" T
HEN GOTO 5050
5070 LET Q=LEN B$
5080 FOR S=Q TO 1 STEP -1
5085 LET A$(X,31-S)=B$((Q+1)-S)
5090 NEXT S
5095 LET X=X+1
6000 PRINT AT 19,29;B$
6010 RETURN
8000 FAST
8010 LET C=0
8020 LET S=0
8030 LET A=1
8040 LET N=340
8050 IF 2**A>N THEN GOTO 8080
8060 LET A=A+1
8070 GOTO 8050
8080 LET F=2**A-1
8090 LET F=INT (F/2)
8100 IF F=0 THEN GOTO 100
8110 LET D=N-F
8120 LET B=1
8130 LET A=B
8140 LET E=A+F
8150 LET C=C+1
8160 IF A$(A)>A$(E) THEN GOTO 82
00
8170 LET B=B+1
8180 IF B>D THEN GOTO 8090
8190 GOTO 8130
8200 LET S=S+1
8210 LET T$=A$(A)
8220 LET A$(A)=A$(E)
8230 LET A$(E)=T$
8240 LET A=A-F
8250 IF A<1 THEN GOTO 8170
8260 GOTO 8140
8500 PRINT AT 20,0;"PREPARE TAPE
 - NEWLINE TO START"
8510 INPUT K$
8520 SAVE "INDEXER"
8530 GOTO 100
8600 SAVE "INDEXER"
8610 GOTO 1
```

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JUMP,

THE SIMPLEST Z-80 processor command is Code 0. This means no operation and is intended to act as a delay, but we will use it initially as a fill-in command to space code out. It also assists in program fault-finding. Its use will be demonstrated later in the first example.

Remember that each piece of machine code is entered into its own address. We start at 16514 and we can jump to any address. That is called an "absolute jump". Alternatively, we can jump forward or backwards a small number of addresses which is known as a "relative jump".

So, if you are at address 16600, a relative jump forward of 50 would take you to address 16650, or we could jump backwards 50 to address 16550. One uses the same command for selective jumps whether they are forwards or backwards. For a backward relative jump, subtract the size of the jump from 256. For example, to jump four bytes backwards jump 252.

The relative jump commands are:

```
JR DIS       24  N
JR Z DIS     40  N
JR NZ DIS    32  N
```

Dis equals displacement and is in fact simply a number, N, between 0 and 255. These commands can be conditional on the state of the F variable, as are the absolute jumps.

Now for an example to demonstrate the use of these commands. Load program 4, which multiplies two numbers, into the Basic program given in program 1. What we will do initially is to change the absolute-address jump to a relative-address jump. After you have entered the program, add the following changes and save 4a.

```
POKE 16524, 32  )  JR NZ DIS
POKE 16525, 252 )
POKE 16526, 0   )  NOP
```

Now program 4a when Run should give precisely the same result as program 4. Re-enter the machine code of program 4a, but enter, say, eight or nine NOPs first. Then Save this as program 4b and run. This should give exactly the same answer as programs 4 and 4a.

If you had used program 4 with the leading NOPs, the absolute address JP NZ NN would have been wrong. What we have here is a piece of code which we can start at any address and it will work with no changes. This is very useful as it enables the programmer to write blocks of code without having to worry about absolute addresses.

Program 4a shows the point from which we count backwards and forwards, this point is always the next instruction past the relative jump, and for the purpose of simplicity, the maximum count in either direction can be considered to be 120.

Address	Machine code	Mnemonic	Basic
16514	33 30 65	LD HL NN	1 LET HL = 16670
	70	LD B (HL)	2 LET B = PEEK HL
	35	INC HL	3 LET HL = HL + 1
	78	LD C (HL)	4 LET C = PEEK HL
	62 0	LD A N	5 LET A = 0
16522	129	ADD A C	6 LET A = A + C
16523	5	DEC B	7 LET B = B -1
16524	194 138 64	JP NZ NN	8 IF B< >0 THEN GOTO 6
16527	79	LD C A	9 LET C = A
16528	6 0	LD B N	10 LET B = 0
16530	201	RET	11 PRINT C

Multiply two numbers

Program 4.

	Machine code	Relative Jumps	Mnemonic	Comments
16514	33 30 65		LD HL NN	
	70		LD B (HL)	
	35		INC HL	
	78		LD C (HL)	
	62 0		LD A N	
16522	129	252	ADD A C	(If the F variable is N2 then
	5	253	DEC B	(jump Dis.
16524	32 252	254 255	JR NZ DIS	
	0	256	NOP	
16527	79	1	LD C A	
	6 0	2 3	LD B N	
	201		RET	

Multiply two numbers

Program 4a.

	Machine code	Relative Jumps	Mnemonic	Comments
16514	33 30 65		LD HL NN	
	70		LD B (HL)	
	35		INC HL	
	78		LD C (HL)	
	62 0		LD A N	
16522	129	253	ADD A C	(Decrease by one variable B
	16 253	254 255	DJNZ DIS	(and if not equal to zero
	0	256	NOP	(jump Dis i.e., back to
	0	1	NOP	(address 16522
16527	79	2	LD C A	
	0	3	NOP	) B is already zero
	0		NOP	)
	201		RET	

Multiply two numbers

Program 4c.

There is a further refinement which can be made by the use of

CODE 16 (DJNZ DIS)

This command automatically decreases variable B by one and if the F variable is not equal to zero, jumps the given displacement forwards or backwards. If the F, or flag, variable is equal to zero it continues with the next command.

Program 4c demonstrates its use. Either reload 4 and:

```
POKE 16523, 16  ) DJNZ DIS
POKE 16524, 253 )
POKE 16525, 0     NOP
POKE 16526, 0     NOP
POKE 16528, 0     NOP
POKE 16529, 0     NOP
```

or enter the code program 4c and Run. Does this give the same result again? What we are doing is gradually refining the simple multiply program to see the effect of the different commands.

Two additional but related commands that we need to examine are Push and Pop. Push places the values held in the relevant pair of variables into a position in memory, otherwise known as the stack.

We can push as many pairs of variables on to the stack as we wish. The command Pop retrieves the variables from the stack. Note, however, that Pop pulls off the last values Pushed. Thus:

```
PUSH HL
POP BC
```

can be used to transfer the contents of HL to BC. It is also very useful for saving the flag variable for later use, and effectively obtaining more than three pairs of variables.

At this point let me explain that when we first call our USR routine, we push a Return address on the stack. This is how the machine knows where to return to. The command Return Pops the next stack address and jumps to it.

Let us now return to the playing board and use some of these commands to simplify the coding. Program 5 is the original and program 5a the simplified version. We no longer have a Basic program equivalent, as we did last month. In its place I have entered comments. The program as entered will produce the same board, in a program of approximately half the size, but it also has other capabilities. Make the following changes:

```
230 PRINT AT K, 11; "*"
POKE 16528, 10
POKE 16562, 10
POKE 16538, 13
RUN
```

and then try:

```
220 FOR K = 2 TO 15
POKE 16541, 12
POKE 16552, 12
RUN
```

We can also move the board anywhere on the screen. The only way of really understanding what is happening is to experiment — continue until the machine-code routines do exactly what you think they should do. It really is a case of practice.

(continued on page 74)

USH POP, AND RUN

Part 2 of Kathleen Peel's machine-code course for beginners tells you how to jump, push and pop. If you want to learn how to write fast machine-code programs read on.



Code	Mnemonic	
0	NOP	
24	JR	DIS
40	JR Z	DIS
32	JR NZ	DIS
16	DJNZ	DIS
245	PUSH	AF

197	PUSH	BC
213	PUSH	DE
229	PUSH	HL
241	POP	AF
193	POP	BC
209	POP	DE
225	POP	HL

```
   1 REM 12345678901234567890123
4567890123456789012345678901234 5
6789012345678901234567890123456 7
8901234567890123456789012345678 9
0123456789012345678901234567890
   2 REM ▒▒
 200 CLS
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 1, above, and right, program 1a.

```
   1 REM 12345678901234567890123
45678901234567890123456789012345
67890123456789012345678901234567
89012345678901234567890123456789
0123456789012345678901234567890
 200 CLS
 210 SLOW
 220 FOR K=2 TO 7
 230 PRINT AT K, 8;"*"
 240 NEXT K
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

(continued from page 72)

Program 5.			*Program 5a.*			
Address	**Mnemonic**	**Machine code**	**Address**	**Mnemonic**	**Machine code**	**Comments**
16514	LD HL NN	33 12 64	16514	LD HL NN	33 12 64	
	LD E (HL)	94		LD E (HL)	94	
	INC HL	35		INC HL	35	
	LD D (HL)	86		LD D (HL)	86	(16521)
	LD HL NN	33 3 0		LD HL NN	33 3 0	
	ADD HL DE	25		ADD HL DE	25	(One more than X in Basic program
	LD A L	125		PUSH HL	229	(220 FOR K=X TO 7
	LD C A	79				
	LD A H	124				
	LD B A	71				
16528	LD (HL) N	54 135	16525	LD (HL) N	54 135	Line across (16528)
	INC HL	35		LD B N	6 7	(One less than X in Basic program
	LD (HL) N	54 131		INC HL	35	(230 PRINT AT K,X;"*"
	INC HL	35		LD (HL) N	54 131	
	LD (HL) N	54 131		DJNZ DIS	16 251	
	INC HL	35		INC HL	35	
	LD (HL) N	54 131		LD (HL) N	54 4	
	INC HL	35				
	LD (HL) N	54 131				
	INC HL	35				
	LD (HL) N	54 131				
	INC HL	35				
	LD (HL) N	54 131				
	INC HL	35				(16538)
	LD (HL) N	54 131				
	INC HL	35				
	LD (HL) N	54 4				
16555	LD DE NN	17 10 0	16537	LD DE NN	17 10 0	(Two more than X in Basic Program
	ADD HL DE	25		LD B N	6 4	(230 PRINT AT K,X;"*"
	LD (HL) N	54 5		ADD HL DE	25	
	ADD HL DE	25		LD (HL) N	54 5	Right-hand line down (16541)
	LD (HL) N	54 5		DJNZ DIS	16 251	One less than X-Y in Basic Program
	ADD HL DE	25		ADD HL DE	25	220 FOR K = Y TO X
	LD (HL) N	54 5		LD (HL) N	54 1	
	ADD HL DE	25				
	LD (HL) N	54 5				
	ADD HL DE	25				
	LD (HL) N	54 1				
16572	LD A C	121	16550	POP HL	225	Left-hand side down (16552)
	LD L A	111		LD B N	6 4	One less than X-Y in Basic Program
	LD A B	120		ADD HL DE	25	220 FOR K=Y TO X
	LD H A	103		LD (HL) N	54 133	
	ADD HL DE	25		DJNZ DIS	16 251	
	LD (HL) N	54 133		ADD HL DE	25	
	ADD HL DE	25		LD (HL) N	54 2	
	LD (HL) N	54 133				
	ADD HL DE	25				
	LD (HL) N	54 133				
	ADD HL DE	25				
	LD (HL) N	54 133				
	ADD HL DE	25				
	LD (HL) N	54 2				
16591	INC HL	35	16561	LD B N	6 7	Bottom line across (16562)
	LD (HL) N	54 3		INC HL	35	
	INC HL	35		LD (HL) N	54 3	One less than X in Basic Program
	LD (HL) N	54 3		DJNZ DIS	16 251	230 PRINT AT K,X:"*"
	INC HL	35		RET	201	
	LD (HL) N	54 3				
	INC HL	35				
	LD (HL) N	54 3				
	INC HL	35				
	LD (HL) N	54 3				
	INC HL	35				
	LD (HL) N	54 3				
	INC HL	35				
	LD (HL) N	54 3				
	RET	201				
	99 Bytes			55 Bytes		

■

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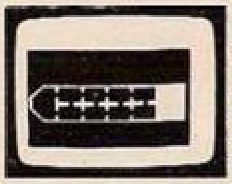
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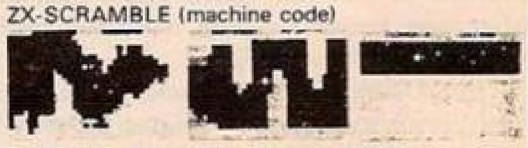


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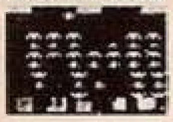


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CONTROL

MIDWICH MC

The Midwich MC is a control computer which should prove very useful in school and university labs for teaching and research. John Dawson interfaces with reality.

IT SEEMS that almost everyone wants to use their computer to make things happens in the real world. Aircraft simulators, robot arms, timing circuits for model racing cars, solar-heating controllers are all popular subjects in both the U.K. and America. But the problem is simply that most amateur or domestic machines are not designed for those purposes.

Either you are in the single-board, machine-code league or the dominant routes in and out of the computer are the keyboard and television. The BBC Micro, model B, is one of the few computers to offer analogue to digital (A-D) converters for measuring a changing input voltage. Nevertheless, you need your own expansion board and your own programs if you want to do very much more than determine the position of a joystick for game playing.

When I opened the box containing the Midwich MC Microcontroller the machine inside seemed to be exactly the computer with connections to the real world that I had been promising myself I would build for the last four years.

The Midwich Microcontroller, like several other British computers, originates from the Silicon Plains of East Anglia. Prices for the machine start at £299 for the 12V version; the mains version reviewed here costs £375, but a £30 discount is available for educational buyers.

Very powerful commands

The Midwich Computer Company Ltd was established in 1979 to distribute and manufacture small computers. The first machine that the company handled was the Nanocomputer by SGS-ATES. Production ceased for that micro at the end of 1980 and yet it seemed that there was a hole in the market that could be filled by a British computer.

David Clarke, Tom Hogan and Ian Johnson thought that the gap was at the low-cost end of the market, and that the plug should be a real-time, user-friendly computer which could educate people in the use of computers for control purposes, while at the same time providing a serious microcontroller in its own right.

While this was happening, Midwich was thinking about a project for batch reactor control using software developed at Oxford University. The special, high-level language written for the reactor-control job evolved into the version of Basic built into the Midwich Microcontroller.

The Basic in the Midwich Microcontroller is similar to Microsoft in many respects and you will have no difficulty in adapting programs or thought patterns to this machine, but I doubt that you will have ever encountered instructions such as DI, EI, Wait, RTI, Sched, Overlay, or DSched.

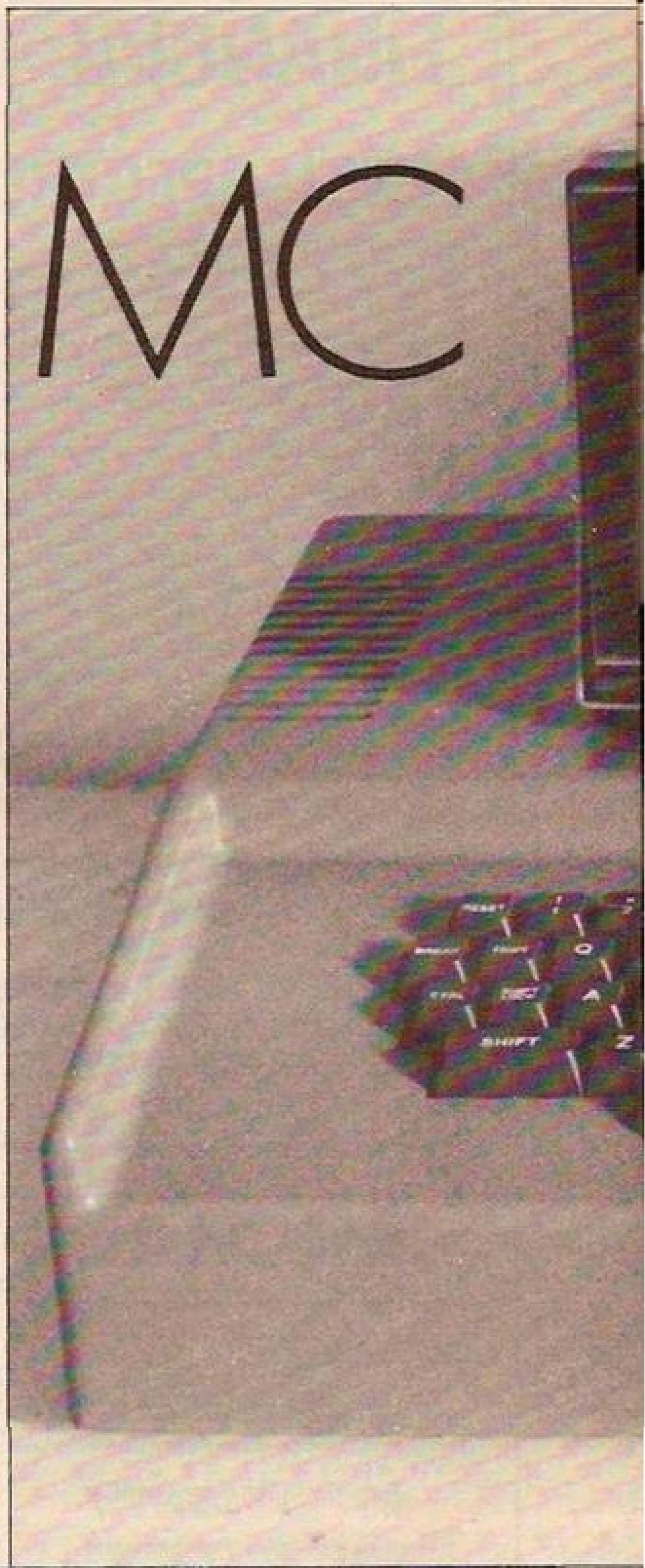
These are the instructions used to run two programs simultaneously so that you can enter immediate commands from the keyboard while the computer is actually running another entirely separate program. These commands are very powerful and, as far as I know, are unique to the Microcontroller Basic.

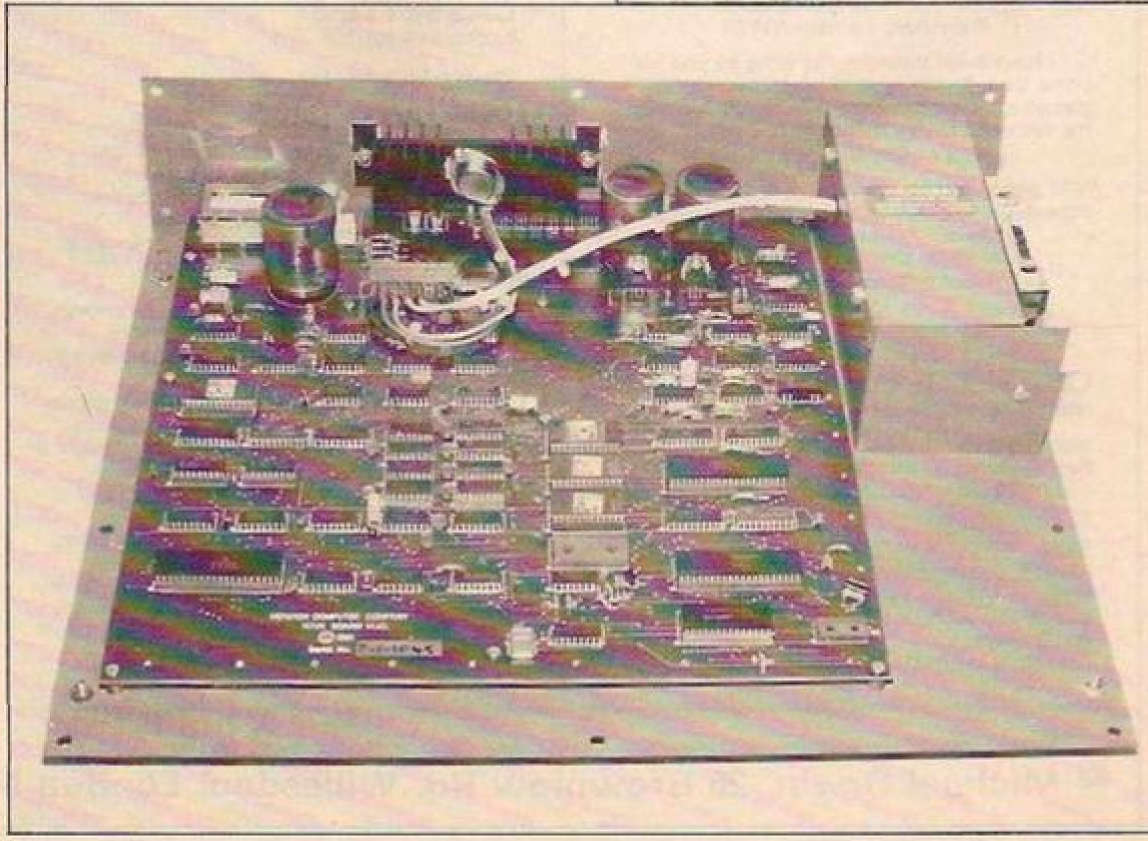
Electrical safety

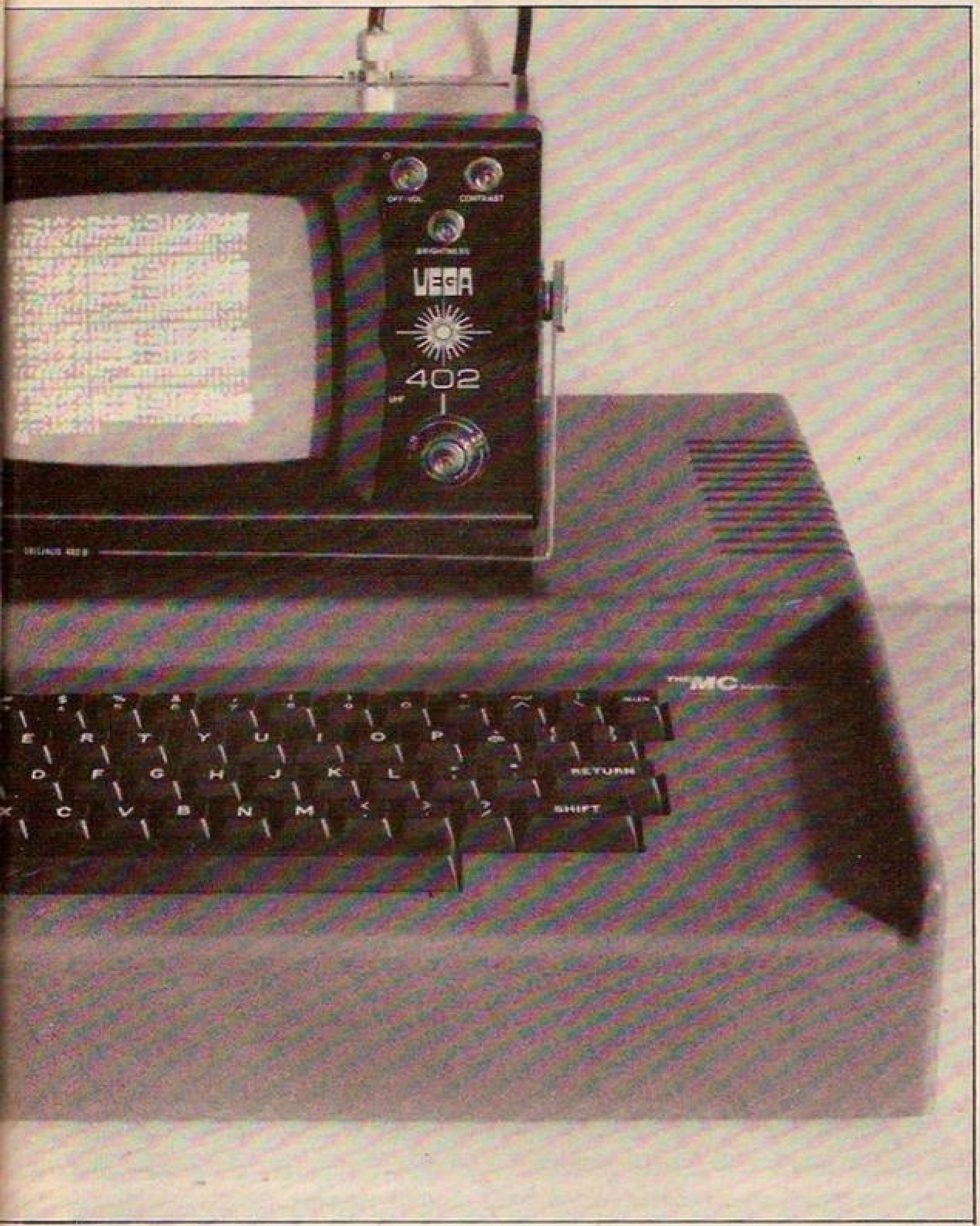
The Midwich Microcontroller is a single-board computer mounted on a substantial steel base plate. The machine is enclosed in a very robust structural foam case — the Apple II uses a similar one although its case is more sharply styled.

The two halves of the case are held together by 15 proper metal screws inserted into brass nuts moulded in the structural foam. This is important because you can open and re-assemble the case as often as you like without stripping the screw threads.

The electrical safety design of the computer is excellent, absolutely first-rate, with wire







mesh over the ventilation slots to prevent little fingers sticking little spanners into the works.

When you look inside, you see that in terms of personal safety — never mind shorting the integrated circuits — the mesh was not necessary because the mains side of the power supply is heavily insulated. You can safely run the computer outside its case for demonstration purposes.

The Midwich Microcontroller uses a single Z-80 microprocessor running at 2 MHz and 16K of dynamic RAM are included on the single board. Figure 1 illustrates the interconnections between various sections of the computer.

Educational plus

There is 12K of ROM which houses the monitor and control Basic interpreter. A Z-80 counter timer chip (CTC) provides a real-time clock and a number of other facilities, and there is one Z-80 PI/O used for the keyboard interface and the cassette I/O.

The expansion unit has a spare 4K EPROM socket. A second board is screwed to the upper half of the case and that holds 57 keys for the keyboard. There are no defined cursor-control keys and no separate numeric keypad. The keyboard is laid out in the standard QWERTY pattern and can generate the full ASCII character set.

At the rear of the computer are sockets for 230V mains power or, with a different power-supply unit, 12V AC. Other sockets provide signals for a cassette recorder, motor control as well as input and output. There are also phono and BNC sockets for UHF signals and video for your VDU. Finally — and this is the Microcontroller's real claim to educational pre-eminence — there is a socket for a bus interface which brings 50 lines out to the experimental unit.

The experimental unit is a double-sided printed-circuit board with a breadboard block mounted as an integral part of the unit. There is a 30-way terminal block which will take ordinary wires from other circuits in your experiments and connect them to four lines from each of the six accessory slots on the experimental unit.

Digital-to-analogue and analogue-to-digital boards can be plugged into the accessory slots and you may then take signals from the real world and convert them into numbers which the Microcontroller can process.

When your program has drawn conclusions from the data you have acquired the machine can send numbers to the D-A converters which will output analogue voltages to the terminal block to control and modify your experimental process.

The breadboard allows you to build a prototype circuit using integrated circuits and other components to connect special transducers such as pH probes, thermocouples, wind-speed sensors, humidity detectors, photocells and pressure gauges to the Microcontroller.

You can buy more experimental units so that several people can prepare hardware for an experiment before plugging it on to the computer bus and devices such as oscilloscopes to run their program.

Versatile form of Basic

Up to six accessory boards can be plugged into the sockets on the experimental unit. Currently available boards include an eight-bit A-D converter, an eight-bit D-A converter and an eight-bit digital input/output board.

Three ranges are provided for both the incoming and outgoing analogue boards: 0V to +10V, -10V to +10V, and 4mA to 20mA positive input or output. The basic range on each type of board is 0 to +2.5V.

The A-D board will accurately follow fast signals as the Ferranti ZN-427 converter chip is placed after a National Semiconductor LF-398 sample and hold chip. The time taken to convert an analogue voltage into a number can make a simple A-D converter inaccurate at quite low frequencies but the Midwich Microcontroller has a professional approach to overcome the problem.

The company has announced two more accessory boards, a 2732 EPROM programmer card and a 12-bit analogue-input board. An IEEE-488 interface should become available within the next three months.

The software is one of the few versions of Basic that takes account of devices other than printers connected to the computer. The Midwich Basic interpreter deserves to be widely copied. It is fast; keywords can be abbreviated to single letters and a full stop; it has a wide range of commands for taking data from the experimental unit and sending information back; and it permits you to work in four different number bases.

Ease of translation

Some like to measure the success of a computer language by the ease of transfer into machine code or assembler — the Midwich Control Basic is very successful in these terms. The format of a USR statement — jump to a machine-code subroutine instruction — is:

```
USR e1, (v1,v2,v3, . . . vn)
```

where "e1" is the address of the routine and "v" represents a series of variables or array elements. Each variable will pass a value to the machine-code subroutine. Both of the following instructions are legal calls to machine-code subroutines:

(continued on page 79)

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(continued from previous page)

USR HEX 3C00, (A(B),N)
USR W, (B,H)

In the first case, the address of the subroutine is at 3C00 hexadecimal and in the second it is at the address stored in the variable marked "W".

The documentation is profuse and excellent. There are many examples to help you with familiar and unfamiliar concepts and while it will take you some time to appreciate the potential of the system, the manual will let you go as far and as fast as you want to.

For example, the following Basic program is given in the manual with a circuit diagram and a good explanation as a trial application. It sets up the computer as an automatic ranging voltmeter:

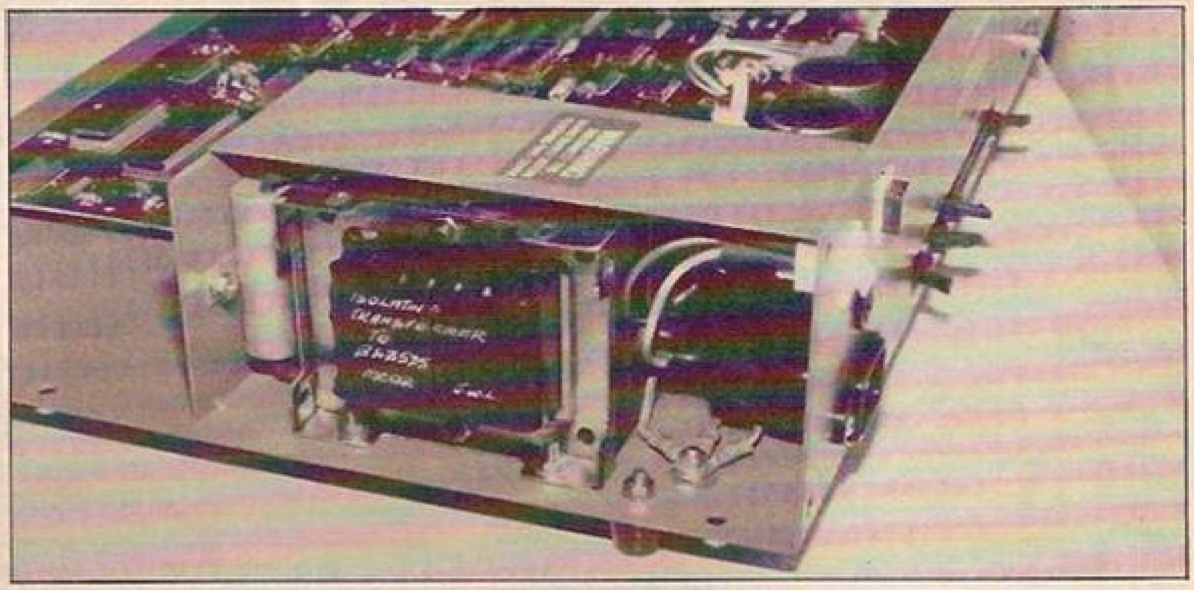
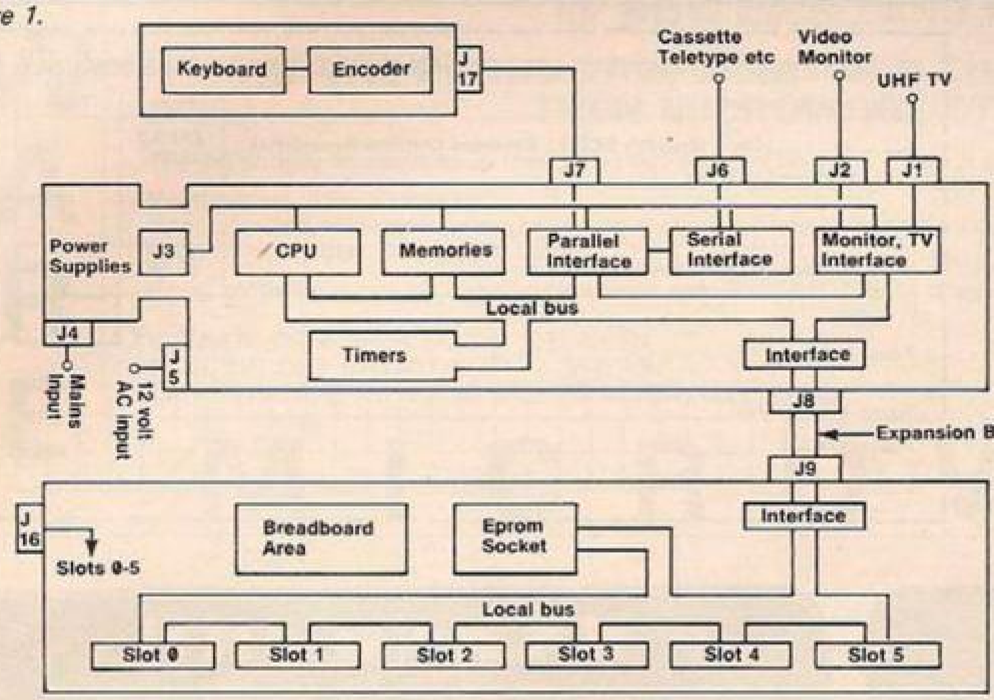
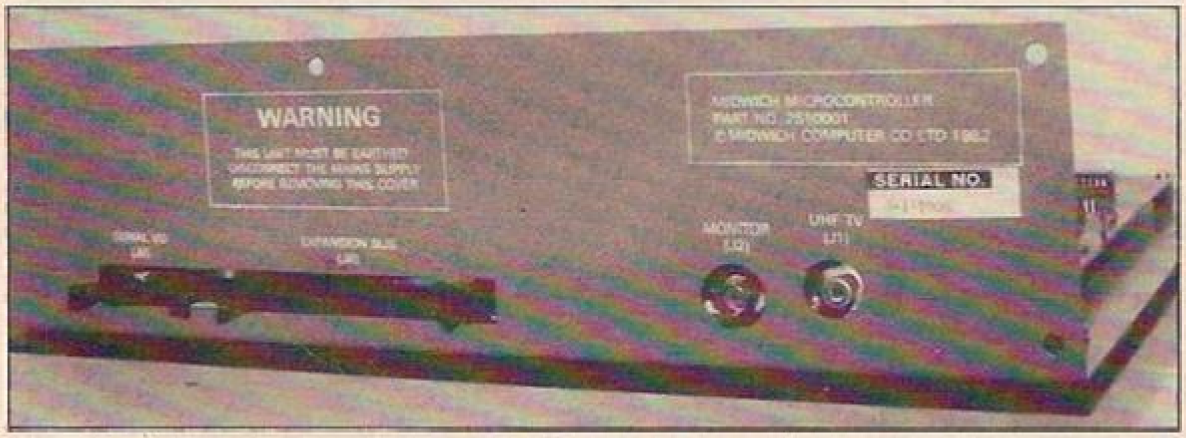


Figure 1.






```
10 P. = 12, : EI
20 OUT (2,15)                  Sets port A
                               as output
30 OUT (0,1)                   Sets op amp
                               on highest
                               gain
40 C = IN(8) : N = 8           Gain = 100
50 IF C < 255 THEN GOTO 1000
60 OUT (0,2)
70 C = IN (8) : N = 4          Gain = 50
80 IF C < 255 THEN GOTO 1000
90 OUT (0,4)
100 C = IN(8) : N = 2          Gain = 25
110 IF C < 255 THEN GOTO 1000
120 OUT (0,8)
130 C = IN(8) : N = 1          Gain = 12
140 IF C < 255 THEN GOTO 1000
150 PRINT "Voltage must be too
    high. DISCONNECT
    IMMEDIATELY" : GOTO 1500
1000 V = (C/255 * N)
1010 PRINT V, "Volts"
1020 Wait (20)
1030 GOTO 10
1040 STOP
```

There are other applications in the extensive documentation for controlling, among other things, lights, demonstrating "aliasing" between an input signal and the sampling rate.

The Microcontroller is available from Datac Ltd, Tudor Road, Altrincham, Cheshire WA14 5TN.

Griffin and George, well-known scientific supplier to the educational market, is distributing the machine and the special 12V version. Griffin and George will also be offering a range of transducers with any necessary electrical interfaces and educational buyers should write to the company, 285 Ealing Road, Alterton, Wembley.

CONCLUSIONS

- The Midwich Microcontroller is a strong competitor with the RML 380-Z for the educational market. The system is less expensive and more attractive in several ways. The concept of the computer as a control device is in the warp and weft of this system.
- The computer is more strongly built than the Acorn Atom and has a greatly increased capability for taking in information, processing it and displaying the results.
- I have a few niggling criticisms of the machine: I did not like the character design and the keyboard is positioned too high by ergonomic standards. But this machine will not be used for word processing by an 80 words-per-minute typist; it does its job and looks able to go on doing it for a long time.
- I would like to have had a cage to protect the accessory boards from accidental knocks, but most users should be able to build something suitable.
- An assembler program is soon to be available and the manual for that looks very good, but I would have thought that this machine was an absolute natural for Forth; I expect to see a version written very shortly by a user, even if Midwich does say that it has no plans for another high level language.
- A high compliment was paid to the Microcontroller unintentionally by a colleague who said he thought it was too well engineered — a case of technical overkill. He clearly did not realise that young engineers and scientists need the best tools. If you are learning a subject you need predictable, reliable machinery so that you can rely on the measurements you make. You should not have to worry about errors contributed by your tools.
- I like the whole system very much. The Microcontroller should be carefully investigated by any science faculty in secondary education considering a computer system for teaching and research. ■

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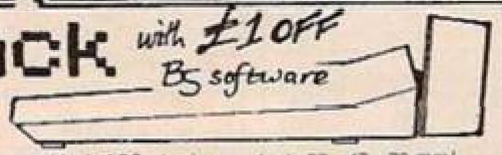
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BBC GUIDE

■ I have just bought a BBC model B machine, and although the provisional guide supplied with the machine is good, it makes no mention of the more advanced features of the machine. Could you tell me if the new guide has been completed, and if so whether it contains an introduction to machine code?

Jonathan McFarlane,
Didsbury, Manchester.

THE BBC says the guide is ready, and will be sent out shortly. My own copy of the new guide, which arrived at the beginning of July, is a massive work of 516 pages. There is a chapter in it called "Assembly Language" which explains reasonably clearly how to use assembler on the computer. It explains how an assembly-language program is 'held' within a Basic program using square brackets, in the same way as assembly-language programs could be easily placed within Basic ones on the Atom. You will find that the explanation of the advantages of staying away from high-level languages such as Basic is sufficiently clear to enable you — with some care — to become proficient at the lower stages of programming other than in Basic. There is a comprehensive discussion of machine-code entry points, and a list of operating system calls.

MORE RAM

■ As you probably know, Mode 7 on the BBC Micro does not offer a high-resolution graphic memory map and as a result uses the least RAM of all the eight modes. It is obviously useful for programs which do not require high-resolution graphics, but need more RAM, such as in an Adventure Game. Is it possible to do the same on the ZX Spectrum resulting in a low-resolution screen memory map and about 14K of RAM for the user, as opposed to the 9K available when high-resolution graphics are utilised? If so, how?

Howard Skoyles,
Great Yarmouth, Norfolk.

THE ANSWER, I am afraid to say, is no. There is no trade-off on the Spectrum, as there is on other micros which have high-resolution graphics, betwen the degree of resolution and available RAM. The resolution for Plot is firmly fixed at 256 by 192, no matter what you do. Therefore, on a 16K Spectrum you are stuck with 9K. However, remember that Sinclair Basic is efficient at packing a good deal into a little RAM space — especially with the use of the one-key entry which stores all the keywords far more economically than most other micros. Therefore, you can enter a surprising amount into the 9K. As well as this, there are a number of well-publicised techniques for making the most of the ZX-81 memory. These techniques will also help you with the Spectrum.

MIC AND EAR

■ I have a question regarding the ZX-81's tape recorder compatibility. As you know, the ZX81 incorporates two sockets marked Ear and Mic, both of which should be connected to their respective two sockets on the recorder. My problem is that I have a Panasonic recorder with only one auxiliary five-pin DIN socket marked REC/PB. Can I Load and Save ZX-81 programs with my Panasonic, and if so, how?

Keith Richmond,
Enfield, Middlesex.

THE SIGNAL sent out by the ZX-81, and expected back by it, is not suitable for an auxiliary plug. You need to plug the Mic output of the ZX-81 into the microphone, and not the Aux, input of the cassette recorder, and the Ear lead of the computer should go into either the headphone or earpiece socket. You may need to have special plugs to make this work. Without adding an extra amplifier between the computer and the recorder, there is no way you can get the computer to work satisfactorily with a DIN arrangement of the type you describe.

COUNT THE DAYS

■ For part of a program for the ZX-81 with 32K I require a method of counting the number of days between specific dates as a double check, and to know the day of the week of the latest date. I have solved the second part of the problem by using part of another program: the first, however, is giving me nightmares especially where the period is longer than a year, and where leap years are involved. I would be grateful if you would either solve the problem or point me in the right direction.

Derek Chadwick,
Kingston, Surrey.

A SUITABLE program — written for a ZX-80 but which can relatively easily be converted to the ZX-81 — is on page 139 of the book *The Gateway Guide to the ZX-81 and ZX-80* by Mark Charlton. Because of the difference in the way the ZX-80 and the ZX-81 evaluate logic, you will have to change some minus signs to pluses, and vice versa.

WRONG NUMBER

■ I am experiencing a most irritating arithmetic problem with my Sinclair ZX-81, with and without 16K. The following simple program demonstrates the problem:

```
10 LET A = 1234.99 + 1234.99
     + 1234.99
20 LET B = 1234.99 + 1234.99
     + 1235 -.01
30 PRINT A - B
```

When this program is Run, the answer — which of course should be 0 — is 9.5367422E-7. If all the values in the program are multiplied by 100 the problem disappears. I need to use this checking routine in a program I am writing for my work — I am an accountant. Please could you explain why this problem occurs and how to cure it?

A R Sampson,
Stroud, Gloucestershire.

NO COMPUTER holds every number exactly, and the ZX-81 is no exception. The degree of accuracy of a computer, and a calculator for that matter, depends on the number of decimal places the number is held to within the computer, and the number of places which is finally displayed. Often this is one less than the number of places to which the computer works. People often make an enormous fuss over these minute errors within computers, forgetting that in the real world we generally work to accuracies which are several orders of magnitude less. The "wrong answer" you claim the computer gives is actually less than .000001 above the true answer. If you are dealing with money in your programs — which seems likely if you are an accountant — you need only two-figure, or at most, three-figure accuracy to represent pounds and pence. If the problem still bothers you, simply multiply everything by 100 while working, and then divide the final answer by 100. Whenever you are working with numbers when the accuracy is important, try to eliminate as many intermediate steps as possible, as each of these can introduce some slight error which can accumulate to a substantial error at the end.

VIC PRINTER

■ I have had a Vic-20 for some months now and I am delighted with it. However, I am taking an O level in computing, and for it I need to write three programs. I need a printer to be able to document it. However, I cannot afford a printer. I would be pleased if you could tell me: Can a printer be rented, and from where and for how much? Is it worth buying the interface that allows the ZX-81 printer to be used with the Vic. This is taking into consideration that I would like to be able to print graphics on it?

Paul Hampson,
Cheddleton, Leek.

FIRSTLY, I do not know whether you can rent a Vic printer in your area. I know the Vic printer is relatively expensive, especially when compared with the price of the computer. Perhaps you could contact the dealer from whom you bought the computer, and ask if it would be possible to visit the shop with a cassette with your three programs on it, and dump them there. I would not be too pushy about this, and you could be considered nothing but a nuisance. However, if you do decide to do this, make sure you have no trouble finding the three programs on your tape. I suggest you make up a tape just with the three on it so you do not tie the shop or the printer up for longer than is strictly necessary. If graphics are important, you should certainly consider buying the interface, as you can easily dump the contents of the screen, graphics and all, with the ZX printer.

SPECTRUM BASIC

■ Having just bought a Sinclair Spectrum, I would like to know whether it is possible to translate some of the wide range of ZX-81 software now available into Spectrum Basic. Is this feasible, and what are the relevant differences in the Basics that need to be considered?

H T Garston Smith,
Broadstairs, Kent.

THE VAST majority of the software sold for the ZX-81 is written in machine code, and the problems of converting that into Spectrum Basic are too horrible to contemplate. However, nearly all ZX-81 program listings can be converted into Spectrum programs without too much trouble. The only command in ZX-81 Basic which does not exist in Spectrum Basic is Unplot, and this can be emulated on the Spectrum with Plot Over. However, Plot works on a much finer grid on the Spectrum than it does on the ZX-81, so you may well want to change the display completely from the ZX-81 program. As well as this, Peeking and Poking into the display file on the Spectrum is far from simple, whereas it can be achieved fairly easily on the ZX-81. There are additional commands, including ATTR and Screens, which are simpler to use than Peeking into the display file, and are available on the Spectrum. I would suggest you type a ZX-81 program in, exactly as it is listed, then set about adding user-defined graphics, colour, sound and so on to make it better. In your early stages of such conversions, I would avoid any program which uses Peek or Poke. ■

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

THE FINGERTIPS COLUMN receives a great number of programs and suggestions — not always totally complimentary. In spite of the advances of the cheap micro, calculator fiends have kept their resolve.

Only a month ago I saw a fully-fledged paper from the Theoretical Physics department of the Lawrence Berkeley Laboratories containing three statistical programs written for experimentalists — and an HP-35 calculator.

Many of you ask what criterion we use for selecting your programs. If there was one word to sum it up it must be imagination. In other words, an entry which has modified the last two lines of a previous month's Hi-Lo program is hardly likely to wake us up as quickly as a Three-Dimensional Chess simulator in 35 lines. In general a game has to be novel. We get about 20 moonlander programs per month.

We also appreciate some programs which show the calculator as a working beast and not just a toy. For the more technically oriented, any new information or interesting quirks — synthetic programming and all that — tends to send us rushing fastest to our well-fingered calculators. Write a program incorporating one of these and it's like icing on the cake. Hand it in well-typed and the money and instant fame are nearly yours. Still, whatever your entry we're glad to receive it and will always read it.

The most frequent suggestions were from readers who take personal affront to the singling out of the large and expensive calculators in this column. Remember — write an interesting article on your cheap programmable, and we'll publish it. But just for you here is a program written for the Casio FX-180P by Mike Shallcross of London with something more serious than games in mind.

As an accountant, he has devised and used the program for checking VAT registration numbers, which use a divisor of 97, but it will work for any normal check digit system. The International Standard Book Numbers, for instance, use a divisor of 11.

Program 1 runs on a Casio FX-180P or equivalent but could doubtless be adapted for most programmable calculators with four memories and conditional loop. It has been made self-initialising as far as possible, and so it is slightly longer than is strictly necessary.

To run the program, if the "K" memories have been cleared or used for other calculations in the meantime, the following steps are necessary:

- Store the divisor in K1
- Without clearing the display, run P1 in order to initialise memories K2 to K4
- To find or verify the check digit(s) for any number, key in the non-check digits and run P1
- For further numbers using the same divisor, simply repeat the last step.

Program 1.

```
Initialise:        MODE 0
                   INV PCL
                   (divisor, e.g., 97)
                   Kin 1
                   P1

Program:           MODE 7 0          INV X-K 4
                   ÷                 ÷
                   1                 Kout 1
                   0                 =
                   Kin + 2           Kin - 2
                   -                 Kout 2
                   Kin 3             -
                   .                 .
                   5                 5
                   =                 =
                   INV RND           INV RND
                   Kin - 3           Kin - 2
                   INV X-K 3         Kout 1
                   x                 Kin x 2
                   Kout 2            1
                   =                 0
                   Kin + 4           INV X-K 2
                   Kout 3            INV RND
                   INV x>0           MODE 9

Leave LRN mode:    MODE
```

Peter Dewell of Redditch follows up the suggestion of more Commodore PR-100 programs — *Your Computer,* May 1982 — with a non-iterative solution to Paul Stockwell's Intersection of two straight lines program. The two or more points for the lines are entered using the regression data key Ci.

(Ci Egn 1) F slope M0 F Intup M1 OM5 M6 M7 M8 M9 R/S.

(Ci Egn 2) F slope M2 F Intup-MR1 (MR0-MR2 = R/S Cs R/S.

If an error message occurs check the contents of M0 and M2 for the same slope, otherwise the error is due to the intersection being out of range.

C Rawlinson has come up with a fishy little program for the Sharp PC-1500 — program 2.

If Roy Sirl will step forward and give us his address he will receive £6 for program 3.

$$\frac{C^{a}_{m} \times C^{b}_{n-m}}{C^{a+b}_{n}}$$

were $C^{x}_{y} = \frac{x!}{y!(x-y)!}$

To run it press 2nd inv c.t.
RST
a STO 4
b STO 5
m STO 6
n STO 1
R/S

After a minute or two the required probability appears. The formula is most useful when applied to a pack of 52 playing cards. In this case a, b, m and n have the following meaning.

a is the number of cards you want.

b is the number of cards you do not want.

m is the number of cards (of the kind you want) that you want.

n is the number of cards you take.

For the probability of three kings in a pack of 52 cards, including four kings in 10 draws.

a = 4, b = 48, m = 3, n = 10
P(a,b,m,n) = 0.0186167.

The TI-57 does not have a factorial button so this is the function of subroutine 0. The subroutine also correctly gives 0! × 1. The program is written without a subroutine to calculate the combinations to, paradoxically, save space. Instead there are nine calls of the factorial routine and some juggling with the memories. The program can be applied to bridge, poker or other card games. For instance, what is the probability in bridge of being dealt all four aces? Here a = 4, b = 48, m = 4, n = 13
p(a,b,m,n) = 0.00264
this is about one hand every 380 deals.

I have compiled tables of the probability of getting x cards out of y cards that I want (x y) for y up to 12.

We had a very lively letter from New Zealander Henry Falkner who has some harsh things to say about all programmables and seems to prefer his Casio 602 to the 702 which he later bought. In his spare time he appears to be the musician for the City of Auckland Morris dancers — is he honest or are we naive? He says that he finds the music adaptor invaluable for some of his songs. Enter the Cloggies.

Finally — this month's program challenge. Write a program to calculate the number of people needed in a group before there is a probability of 60 percent for any two of the people to have identical birth-dates.

Program 2. It is remarkable how the non-technically-minded are more impressed by simple programs than by the most complex and difficult ones. This one never fails to amuse the uninitiated. After the Print statement in lines 20, 30 and 40, a fish swims lazily across the display.

```
10:   WAIT 100
20:   PRINT "   THIS is what you get"     (3 spaces)
30:   PRINT "       for using a"          (7 spaces)
40:   PRINT "  LIQUID crystal display"    (2 spaces)
50:   CLS
60:   WAIT 0
70:   FOR C = 0 TO 155
80:   GCURSOR C
90:   GPRINT 65;34;62;28;28;28;28;62;62;62;62;62;63;53;
      127;127;127;127;127;127;127
100:  GPRINT 127;127;58;62;28;8  (90 AND 100 PRODUCE THE FISH)
110:  GCURSOR C
120:  GPRINT 0
130   GCURSOR 0   (IT IS NOT OBVIOUS WHAT THESE TWO LINES DO,
140:  GPRINT 0,0;0;0,0,0       BUT TRY IT WITHOUT AND SEE)
150:  NEXT C
160   END
```

(continued on next page)

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Program 3. The TI-57 probability program.

Key	Loc	Code
RCL 4	00	33 4
SUM 3	01	34 3
SBR 0	02	61 0
STO 2	03	32 2
RCL 5	04	33 5
SUM 3	05	34 3
SBR 0	06	61 0
2nd Prd 2	07	39 2
RCL 1	08	33 1
SBR 0	09	61 0
2nd Prd 2	10	39 2
RCL 6	11	33 6
SBR 0	12	61 0
2nd INV Prd 2	13	-39 2
RCL 3	14	33 3
SBR 0	15	61 0
2nd INV Prd 2	16	-39 2
RCL 1	17	33 1
INV SUM 3	18	-34 3
RCL 3	19	33 3
SBR 0	20	61 0
2nd Prd 2	21	39 2
RCL 6	22	33 6
INV SUM 1	23	-34 1
INV SUM 4	24	-34 4
RCL 1	25	33 1
INV SUM 5	26	-34 5
SBR 0	27	61 0
2nd INV Prd 2	28	-39 2
RCL 5	29	33 5
SBR 0	30	61 0
2nd INV Prd 2	31	-39 2
RCL 4	32	33 4
SBR 0	33	61 0
2nd INV Prd 2	34	-39 2
RCL 2	35	33 2
RIS	36	81
RST	37	71
2nd Lbl 0	38	86 0
STO 0	39	32 0
2nd Lbl 1	40	86 1
RCL 0	41	33 0
X	42	55
2nd Dsz	43	56
GTO 1	44	51 1
2nd x=t	45	66
CLR	46	15
1	47	01
=	48	85
INV SBR	49	-61

Cloggies' program.

```
*** P1
Min6 Min6 Min5 Min4
MR4 Min8 Min3 Min5
Min5
.
MR5 Min6 Min5 Min4
MR2 Min2 Min5 Min4
Min3
MR4
AC
*** P2
Min4
MR5 Min1
MR1 Min1 Min5 Min5
Min6
.
MR7 Min6 Min5 Min4
Min6 Min7 Min8 Min1
Min4 Min3
MR4
MR5 Min1
MR1 Min1 Min5 Min5
Min6
MR7 Min6
.
MR7
MR6 Min5
.
MR4
MR6 Min7
.
MR8
MR1 Min4
.
MR3
MR4
AC

*** P0
M+F
6SBP1
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
6SBP2
6SBP1
6SBP1
HLT
6SBP2
AC

MEMORY LIST
MF=      7.
M9=     48.
M8=     54.
M7=     61.
M6=     64.
M5=     72.
M4=     82.
M3=     87.
M2=     97.
M1=    118.
M0=      0.
```

Software File gives you the opportunity to have your programs, ideas or discoveries published. We will accept contributions for any personal computer and will group programs for like machines together in the file. Please double-check your listings before sending them, and specify the memory they require. Mark your letter clearly for *Your Computer.* We will pay £6 for each contribution published.

Landscape

Garry Owens,
Leamington Spa,
Warwickshire.

ZX-81

IN THIS ARCADE-type game for a 16K ZX-81 you are in control of an aircraft, the symbol >, flying over a mountainous landscape. Ground-based forces are firing missiles, letter As, at you and you must destroy the missiles and their fuel dumps, Qs, with your laser cannon and bombs.

Displayed at the top of the screen are your score and number of aircraft left — you start with five. You score 10 points for destroying a missile and 50 points for hitting a fuel dump. You lose a life if your aircraft is hit by a missile or if you crash into the mountain.

The control keys are:

6 — moves the aircraft down
7 — moves the aircraft up
8 — thrusts forward more quickly
9 — drops a bomb
0 — fires a laser cannon.

This program is based around eight machine-code subroutines:

16800 to 16854	control movement of aircraft
16857 to 16914	fire laser cannon
16915 to 16952	drop a bomb
16955 to 16989	scroll main part of display right to left
16992 to 17080	draw the landscape
17100 to 17180	increment score by 10
17190 to 17328	move bombs down and missiles up
17335 to 17348	check no missile has hit aircraft.

The routines are called from a Basic program. Lines 1 to 3 use the machine-code routines and data; lines 4 to 90 the initialisation; lines 100 to 200 the main game; and lines 400 to 610 the crashing routine.

Bytes 16514 to 16720 are used as storage and data by the machine-code subroutines; 16514 to 16517 store the score; 16518 and 16519 hold the addresses of the aircraft on the screen; 16520 and 16521 hold the addresses of the next data item for the landscape-drawing routine; 16522 is the time since the last A was placed on the screen; 16523 is the time since the last Q was placed on screen; and 16526 to 16718 deal with the data for the landscape-drawing routine.

To set up the routines enter fast mode and enter as line 1 a Rem statement of 278 zeros — eight whole lines plus 22. Then Edit line 1, rub out the line number and change it to 2, add 10 more zeros and press Newline. Edit line 2 and make it line 3. Peek 16792 should be 118. Peek 16800 should be 28 and Poke 16800, 128 should put an inverse space just after the Rem in line 2.

Now type in the short Basic program in program 1. This sets up the data for drawing the landscape. Run and then delete lines 10 to 60 and add program 2. This program Pokes the hexadecimal values of the machine-code routines — programs 3 to 10 — into the Rem statements. You had better save the program now to stop it accidentally disappearing into thin air.

Now add the lines in program 11. This is the final program. Save it now or you may regret it later. Run it in slow mode and see what happens. If it crashes go back and check that the machine-code routines are correct using a disassembler such as that suggested by Chris Lam in the May 1982 issue.

Program 1.

```
   10 LET L$="46688CEEGCC88665656
4246642468642468CEGIECA8666A6666
A68A88646668AEGEEC8A8A8664466666
66426AC8864246AACA8ACE688886442246
44666468A468ACEC8CGC8IGCE24CAE6C
6C8EAC8A68462ECA888GECAA88664246
86A8CAECGEC8422BB"
   20 FOR L=1 TO LEN L$
   25 REM LEN L$<200
   30 POKE 16525+L,CODE L$(L)-28
   40 NEXT L
```

Program 2.

```
9000 PRINT "START ADDRESS?"
9010 INPUT X
9020 LET A$=""
9030 IF A$="" THEN INPUT A$
9035 IF A$="S" THEN GOTO 9100
9040 SCROLL
9050 PRINT A$( TO 2)
9060 POKE X,16*CODE A$+CODE A$(2
)-476
9070 LET X=X+1
9080 LET A$=A$(3 TO )
9090 GOTO 9030
9100 SCROLL
9110 PRINT "FINISH ADDRESS ";X-1
9120 STOP
```

Program 3.

```
START 16800
2A  86  40  36  00  3A  26
40  CB  6F  20  04  11  21
00  19  CB  67  20  04  11
DF  FF  19  7E  FE  00  20
09  36  12  01  00  00  22
86  40  C9  FE  80  20  09
2A  86  40  36  12  01  00
00  C9  01  01  00  C9
                FINISH 16854
```

Program 4.

```
START 16857
3A  26  40  CB  4F  C0  2A
86  40  06  18  00  23  7E
FE  00  28  18  FE  08  C8
FE  26  36  00  CC  CC  42
FE  26  C8  FE  36  20  14
C5  06  05  CD  CC  42  10
F9  C1  C9  36  16  C5  06
7F  10  FE  C1  36  00  10
D2  C9
FINISH 16914
```

Program 5.

```
START 16915
3A  26  40  CB  57  C0  2A
86  40  11  22  00  19  7E
FE  26  CC  CC  42  C8  FE
36  20  08  06  05  CD  CC
42  10  FB  C9  FE  08  C8
36  1B  C9
FINISH 16952
```

Program 6.

```
START 16955
2A  86  40  36  00  2A  0C
40  11  44  00  19  06  16
C5  06  1F  7E  2B  77  23
23  10  F9  23  23  C1  10
F1  2A  86  40  C3  B8  41
                FINISH 16989
```

Program 7.

```
START 16992
2A  88  40  7E  23  22  88
40  FE  80  20  09  01  8E
40  ED  43  88  40  20  EB
2A  0C  40  11  62  00  19
11  21  00  06  15  36  00
19  10  FB  11  DF  FF  47
36  08  19  10  FB  3A  8A
40  FE  04  20  0B  E5  36
26  21  8A  40  36  00  E1
18  04  3C  32  8A  40  3A
8B  40  FE  0F  20  08  36
36  21  8B  40  36  00  C9
3C  32  8B  40  C9
                FINISH 17080
```

Program 8.

```
START 17100
E5  F5  C5  3A  82  40  C6
01  32  82  40  FE  26  20
2F  3E  1C  32  82  40  3A
83  40  C6  01  32  83  40
FE  26  20  1E  3E  1C  32
83  40  3A  84  40  C6  01
32  84  40  FE  26  20  0D
3E  1C  32  84  40  3A  85
40  C6  01  32  85  40  2A
0C  40  23  11  85  40  06
04  1A  77  23  1B  10  FA
C1  F1  E1  C9
                FINISH 17180
```

Program 9.

```
START 17190
2A  0C  40  11  F6  02  19
2B  06  15  C5  06  20  7E
FE  00  28  35  FE  08  28
31  FE  1B  20  2D  E5  36
00  11  22  00  19  7E  FE
00  20  04  36  1B  18  1C
FE  08  28  FA  FE  26  CC
CC  42  36  00  28  0F  FE
36  20  0B  C5  06  05  CD
CC  42  10  FB  C1  36  00
E1  2B  10  C3  2B  C1  10
BC  23  23  06  15  C5  06
0A  7E  FE  26  20  23  E5
36  00  11  DF  FF  19  7E
FE  80  28  16  FE  1B  20
07  CD  CC  42  36  00  18
0B  00  00  00  00  00  00
00  00  00  36  26  E1  23
10  D5  11  17  00  19  C1
10  CB  01  00  00  C9
                FINISH 17328
```

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Program 10.

```
START 17335
2A  06  40  7E  FE  12  01
30  00  C8  01  01  00  C9
                FINISH 17348
```

Program 11.

```
4 REM **(C)G.OWEN,JUNE 1982**
5 LET C=0
6 RAND
10 FOR S=16514 TO 16517
11 POKE S,28
12 NEXT S
13 PRINT AT 0,0;"0000";AT 0,31
;"5"
15 POKE 16520,142
16 POKE 16521,64
17 POKE 16522,RND*3
18 POKE 16523,RND*3
20 LET DF=PEEK 16396+256*PEEK
16397
24 REM **LINE 25,WITH CREDIT A
ND THANKS TO T.GILBERT(FEB,82)**
25 POKE 16418,0
30 PRINT AT 0,4;"0[redacted]"
35 PRINT "[redacted]"
40 PRINT AT 23,0;"[redacted]"
75 LET SP=DF+334
80 POKE 16518,SP-256*INT (SP/2
56)
85 POKE 16519,INT (SP/256)
100 IF INKEY$="8" THEN IF (USR
16955) OR (USR 16992 AND 0) THEN
 GOTO 400
110 IF USR 16800 THEN GOTO 400
130 LET M=USR 16867+USR 16915
135 IF USR 17190 OR USR 16955 T
HEN GOTO 400
140 LET M=USR 16992
150 IF USR 16900 OR USR 17190 O
R USR 17335 THEN GOTO 400
160 IF PEEK (PEEK 16520+256*PEE
K 16521)=11 THEN GOTO 500
190 GOTO 100
400 LET SP=PEEK 16518+256*PEEK
16519
410 POKE SP,146
430 LET C=C+1
435 PRINT AT 0,31;5-C
440 IF C=5 THEN GOTO 600
445 FOR S=2 TO 22
450 PRINT AT S,0;"
                  "
455 NEXT S
460 GOTO 75
500 POKE 16520,142
510 POKE 16521,64
520 GOTO 100
600 PRINT AT 10,5;"GAME OVER"
8999 STOP
```

Life expectancy

Bharat Patel,
Shaw,
Oldham.

VIC-20

LIFE EXPECTANCY runs on a Vic-20 without any additional memory. It is made up of Print statements and is very easy to follow. If anything is printed that does not answer a question, a message is given to repeat the correct answer. There are some unusual marks in the program listing; these are only graphic symbols — they provide capital letters when run — and are obtained via the Shift key or the Commodore flag.

The program asks you many questions on your daily life and activities and at the end the computer will produce an expected date to which you should live — it also tells you if your habits are so bad that you should be dead. The questions go into detail about your fitness, age, family, whether you smoke — and if so how many a day — and many other things.

```
1 REM"LIFE ¬XPECTANCY"
2 PRINTCHR$(14)
3 L=100
5 PRINT"J"
10 PRINT"■/AME PLEASE":INPUTN$
20 PRINT"♠GE PLEASE":INPUTAGE
25 PRINT"J":PRINT"":PRINT"♠RE YOU -EMALE OR \ALE":PRINT"":PRINT"(\ OR -)
27 INPUTSE$
28 IFSE$="M"THENLETSE=69
29 IFSE$="F"THENLETSE=74
30 BIRTH=1981-AGE
100 PRINT" $OUR BIRTHDAY,■"N$,""
110 PRINT" WAS IN "BIRTH:FORI=1TO2000:NEXTI
200 PRINT"J";" ♠RE YOU MARRIED":INPUTY$
210 IFY$="Y"ORY$="YES"THENLET    L=L-1:GOTO220
212 IFY$="N"ORY$="NO" THEN220
215 IFY$<>"Y"THENPRINT"  ¬ON'T UNDERSTAND ":FORU=1TO2000:NEXT:GOTO200
220 PRINT"J";"":PRINT"♠RE YOU -ICH OR ¬OOR    OR \IDDLE( R-P-M )
230 INPUTR$
240 IFR$="R"ORR$="P" THENLETL=L-2:GOTO250
242 IFR$="M"THENLETL=L-1:GOTO250
243 IFR$<>"P"THENPRINT" ¬ON'T UNDERSTAND ":FORG=1TO2000:NEXT:GOTO220
250 PRINT"J  ♠RE YOU OVERWEIGHT":PRINT:PRINT"( I OR /)
260 INPUTW$
270 IFW$="Y"ORW$="YES"  THENLETL=L-1:GOTO280
272 IFW$<>"N"THENPRINT" ¬ON'T UNDERSTAND":FORAA=1TO2000:NEXT:GOTO250
280 PRINT"J"
290 PRINT" ¬O YOU EXERCISE OFTEN":PRINT"":PRINT"(1-♠LWAYS 2-/EVER        3-♠OMET
IMES)"
300 INPUTEX
310 IFEX = 2 THENLETL=L-1:GOTO330
320 IFEX = 3 THENLETL=L-0:GOTO330
322 IFEX<>1THENPRINT" ¬ON'T UNDERSTAND":FORY=1TO2000:NEXT:GOTO280
330 PRINT"J":PRINT"¬O YOU ¬RINK":PRINT"":PRINT"(1-\ODERATELY          2-IEAVILY
":PRINT""
340 PRINT" 3-/EVER"
350 INPUTD
360 IFD=2THENLETL=L-1:GOTO400
370 IFD=1THENLETL=L-0:GOTO400
380 IFD<>3THENPRINT" ¬ON'T UNDERSTAND":FORVV=1TO2000:NEXT:GOTO330
400 PRINT"J":PRINT"¬O YOU SMOKE( I OR /)
410 INPUTSM$
420 IFSM$="Y"ORSM$="YES"THENLETL=L-1:GOTO422
421 IFSM$<>"N"THENPRINT" ¬ON'T UNDERSTAND":FORSQ=1TO2000:NEXT:GOTO400
422 IFSM$="Y"ORSM$="YES"  THENPRINT:PRINT" IOW MANY A DAY";:INPUT HW
423 IFHW>20THENLETL=L-2
424 IFHW<20THENLETL=L-1
425 IFHW>50THENLETL=L-2
430 PRINT"J":PRINT" ♠RE YOU OFTEN ILL":PRINT"":PRINT"  ( I OR /)
440 INPUTIL$
450 IFIL$="Y"ORIL$="YES"THEN  LETL=L-1:GOTO455
451 IFIL$<>"N"THENPRINT" ¬ON'T UNDRESTAND":FORXX=1TO2000:NEXT:GOTO430
455 PRINT"J"
460 PRINT:   PRINT" ♠RE YOU OFTEN TENSE":PRINT"":PRINT" (Y OR N)
470 INPUTT$
480 IFT$="Y"ORT$="YES"  THENLET L=L-1:GOTO498
485 IFT$<>"N"THENPRINT" ¬ON'T UNDERSTAND":FORSAX=1TO2000:NEXT:GOTO455
498 VOL=36878
499 POKE36878,15
500 PRINT"J":FORVV=128TO140:POKE36879,VV:POKEVOL,15:     POKE36875,210:FORG=1TO
100:NEXTG
503 POKE36878,0:NEXTVV
510 POKE36879,122
520 PRINT"■****$LIFE ¬XPECTANCY■***"
530 PRINT:PRINT
540 XX=(L/100)*SE
550 X1=XX
560 PRINT"  OU WILL LIVE UNTIL  "X1" YEARS OLD    "
570 X3=INT(XX-AGE)
580 IFX3<0THENPRINT"   OU SHOULD HAVE BEEN    BURIED--BY NOW ---":END
590 PRINT"************************"
600 PRINT:PRINT:PRINT"■IHEREFORE YOU SHOULD    LIVE UNTIL "X3"  "        MORE
YEARS "
READY.
```

Change of memory

Gavin Warren,
Redbarn,
Hertfordshire.

VIC-20

WHEN THE Vic is expanded to have more than 8K of RAM, the system reshuffles the screen and the start of Basic text, and this makes running any machine-code programs written for the unexpanded Vic impossible.

To solve the problem I wrote a simulator program. The program changes memory size, sets the screen start to 7680 again and sets the start of Basic to 4096 as on the unexpanded Vic.

If the program is loaded and run before using the desired program, no problems should be encountered.

```
10 POKE 648,30
20 POKE 36866,150
30 POKE 55,0: POKE 56,30
40 POKE 52,0: POKE 53,30
50 POKE 643,0: POKE 644,32
60 POKE 641,0: POKE 643,16
70 CLR
80 PRINT "(CLR) (BLUE)"
90 POKE 36869,240
100 POKE 43,1: POKE 44,16
110 POKE 4096,0
120 NEW
```

Key routine

P J Mills,
Tongham,
Surrey.

ATOM

IN MAY SOFTWARE File, G E Taylor gave some examples of the use of subroutines #FE71 in the Atom monitor. Since machine-code routines run far faster than Basic programs, it is best to obtain the fastest possible running speeds for, say, games, and then slow them down to the desired speed.

This program will not only read the keyboard, but also takes no action if #FF is returned in the Y register, and will reject all but the keys used by the program. The advantage of the program is that it checks for the valid keys in the assembled program so it does not have to be re-linked every time an incorrect key is pressed.

As an extra, the two subroutines will move a variable-sized cursor across the bottom of the screen in Mode 0. The keys I used were A and D. Remember that the value returned in the Y register is the ASCII value of the key minus #20. A or D must be pressed before the cursor will appear on the screen. The program requires 855 bytes.

5	Set space for labels
7	Choosing of bat size
10	Clear graphics mode
15	Set up basic constants
25-55	Read keyboard
60-65	Set #80 if A pressed
70-75	Set #80 if D pressed
85	Run assembled program
90-100	Set up Gosub jump
110	Rerun assembled program
1000-1030	Move left subroutine
1200-1230	Move right subroutine
1010/1210	Rub out cursor in last position
1020/1220	Reprint cursor in new position

Here are the constants and variables:

X	nth cursor position
Z	n-1 cursor position used in right subroutine
C	n-1 cursor position used in left subroutine
M	May be changed, gives a very crude speed control
QQ	Assembler labels
W	Value returned from assembler program — also used in subroutine or Next loop
E	Calculated Gosub

As there are some forward jumps in the assembler program the program must be run twice. Therefore once the screen goes blank, press Break followed by typing Old and then Run.

```
5     DIM QQ(3), P(-1)
7     INPUT "BAT SIZE", T
10    CLEAR 0
15    X = 20; Z = 0; C = 0; M = 1
20    PRINT $21
25    [
30    :QQ0 JSR #FE71
35    CPY @#FF; BEQ QQ0
40    CPY @#21; BEQ QQ1
45    CPY @#24; BEQ QQ2
50    \ANY NO. OF KEYS CAN BE
51    \CHECKED IN THIS WAY
55    JMP QQ0
60    :QQ1 LDA @0; STA #80
65    RTS
70    :QQ2 LDA @200; STA #80
75    RTS
80    ]
82    PRINT $6
85    LINK QQ0
90    W = ?#80; E = 1000 + W
100   GOSUB E
110   GOTO 85
200   END
1000  X = X - (T + 1); C = X + (T + 1)
1010  FOR W = 0 TO T; PLOT 15,(C + W),0; NEXT; X = C - M
1020  FOR W = 0 TO T; PLOT 13,(X + W),0; NEXT
1030  RETURN
1200  X = X + (T + 1); Z = X - (T + 1)
1210  FOR W = 0 TO T; PLOT 15;(Z + W),0; NEXT; X = Z + M
1220  FOR W = 0 TO T; PLOT 13;(X + W),0; NEXT
1230  RETURN
```

The Pac-Man trail

Chris Lam,
Redhill,
Surrey.

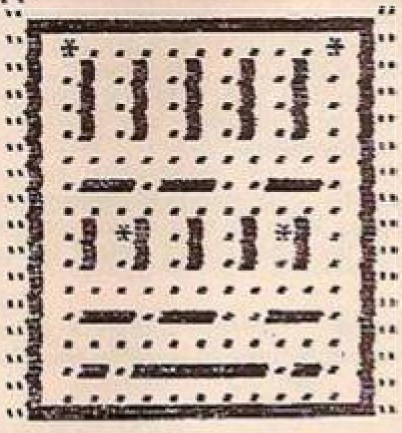
SPECTRUM

THIS IS A Pac-Man-type program for the 16K Spectrum. While playing you are constantly informed of your score, the number of lives you have left, and power. When you eat an asterisk — a power pill — it will boost your score by 10 and your power by 40. When your power is not zero, you can eat the ghost and gain 50 points.

You have four lives and if you are good enough, the game could last for ever. Lines 50 and 55 detect the movement of the Pacman controlled by the cursor keys. Lines 220 and 230 make the ghost follow you randomly. Depending on line 220, the Pacman is a @ symbol and the ghost is a "c".

Lines 1000 to 1150 can be changed to make the maze larger. You must also make appropriate changes to lines 50 and 55.

```
  1 REM  "PAC-MAN" © Chris Lam
  2 LET power=0: LET ss=0: LET
l=0
  3 BORDER 6: PAPER 6: INK 0: C
LS
  5 LET ll=4: LET count=0: LET
g1x=15: LET g1y=10
  6 PRINT AT 19,13;"Lives=";AT
1,12;"Score=";AT 2,12;"Power="
 10 LET l=l+1
 11 RESTORE 1000
 20 FOR n=3 TO 16: READ a$: PRI
NT AT n,10;a$: NEXT n
 30 LET X=21: LET Y=17
 40 PRINT AT 19,19;ll;AT 1,19;s
s;"   ";AT 2,19;power;"   "
 41 PRINT AT Y,X;"@": LET XX=X:
 LET YY=Y
 43 IF power<>0 THEN LET power=
power-1
 45 PRINT AT g1y,g1x; OVER 1;"©
"
 50 LET X=X+(INKEY$="8" AND X<2
1)-(INKEY$="5" AND X>11)
 55 LET Y=Y+(INKEY$="6" AND Y<1
7)-(INKEY$="7" AND Y>4)
 56 LET S$=SCREEN$ (Y,X)
 57 IF CODE S$=0 OR (CODE S$>12
7 AND CODE S$<144) THEN GO TO 10
0
 58 IF s$="*" THEN LET power=40
: LET SS=SS+10
 60 IF s$="." THEN BEEP .05,4:
LET SS=SS+1: LET count=count+1
 63 IF count/l=105 THEN GO TO 1
0
 64 GO SUB 200
 65 PRINT AT YY,XX;" "
 70 GO TO 40
100 LET X=XX: LET Y=YY: GO TO 5
8
200 REM  move ghost
210 LET g1xx=g1x: LET g1yy=g1y
220 LET rx=RND
230 LET g1x=g1x+(rx>.8 AND g1x<
x AND g1x<21)-(rx>.8 AND g1x>x A
ND G1x>11)
240 LET g1y=g1y+(rx>.5 AND g1y<
17)-(rx<.5 AND g1y>4)
250 PRINT OVER 1;AT g1yy,g1xx;"
©"
255 IF g1xx=x AND g1yy=y THEN G
O TO 270
256 IF g1x=x AND g1y=y THEN GO
TO 270
260 RETURN
270 IF power<>0 THEN GO TO 300
280 LET ll=ll-1: IF ll=-1 THEN
GO TO 290
285 PRINT AT YY,XX;" ": GO TO 3
0
290 PRINT " Hard Luck!"'"You're
too slow"'"Ha! Ha! Ha!": STOP
300 REM  Eaten Ghost
301 LET power=0
302 LET ss=ss+50
303 LET g1x=16: LET g1y=10
305 RETURN
1000 DATA "
1010 DATA "
1020 DATA "
1030 DATA "
1040 DATA "
1050 DATA "
1060 DATA "
1070 DATA "
1080 DATA "
1090 DATA "
1100 DATA "
1110 DATA "
1120 DATA "
1130 DATA "
1140 DATA "
1150 DATA "
```



Cartoon time

J P Riggs,
Gosport,
Hampshire.

BBC

THIS PROGRAM will give you an insight into the graphical possibilities of the BBC microcomputer. It starts in a living-room of a house, with a television in one corner showing *The Space Programme* where you are about to witness the take-off of an *Apollo* rocket into space. It lands on the moon's surface, takes off again, orbits the earth and plunges into the sea awaiting rescue.

The program is designed for the B machine but with small modifications will be able to run in lower modes. Converters to lower modes should note that lines 50, 170, 320 and 400 are where modes are set and text and graphic windows are defined. Sound has been incorporated for added realism.

Line 50 makes the screen white by drawing two triangles and filling them in using the Plot 85 command.

60 to 70 give the room its walls and ceiling.

80 to 100 draw the plush carpet on the floor.

110 to 270 draw the television, door, picture, etc.

Line 170 defines the text window — see VDU statements in manual.

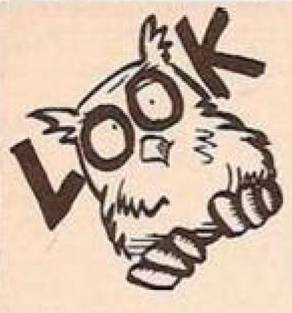
Line 320 defines the graphics window.

330 to 380 are the calls procedures. The main body of the program.

390 to 420 ends the program resetting windows.

430 to 440 clear the television's screen.

(continued on page 93)



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— R.L., Cheshire

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— S.L., Berks

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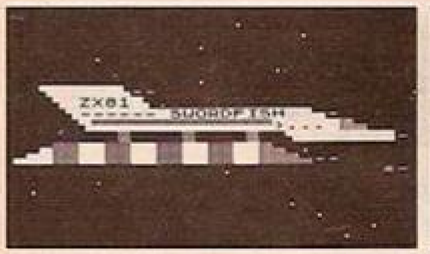
CASSETTE SIX
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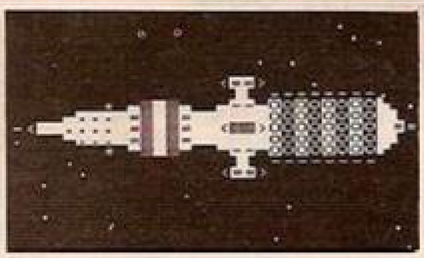
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adventure

SPECTRUM ZX81 BBC nascom

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(continued from page 91)

450 to 600 are the re-entry Procedure and draw Earth and the rocket orbiting.

610 to 650 are the wait Procedure, and delay the program for "s" seconds.

660 to 740 are the take-off Procedure and draw Cape Canaveral with its launch-pad and rocket, and after a 10-second countdown ignition commences.

750 to 810 make the rocket travel through the void of endless space, forever coasting.

820 to 950 draw the moon and make the lander craft descend, land and take-off again ready for its trip back to Earth.

960 to 1070 create the final descent to Earth.

```
>LISTING OF MOONLANDING ON TV By J.Riggs
   10 REM   Moonlanding on Television
   20 REM        By J.P.Riggs   1982
   30 REM              GOSPORT
   40 ON ERROR GOTO390
   50 MODE0:MOVE0,0:DRAW0,1024:PLOT85,1280,1024:MOVE1280,0:PLOT85,0,0
   60 MOVE200,200:PLOT7,200,800:PLOT7,1080,800:PLOT7,1080,200:PLOT7,200,200
   70 MOVE200,800:PLOT7,0,1024:MOVE1080,800:PLOT7,1280,1024
   80 FORX=0TO1280 STEP5
   90   MOVEX,0:PLOT7,((880/1280)*X+200),200
  100   NEXT
  110 MOVE300,200:PLOT7,300,600:PLOT7,475,600:PLOT7,475,200
  120 MOVE880,620:PLOT7,1000,620:PLOT7,1000,500:PLOT7,880,500:PLOT7,880,620
  130 MOVE870,630:PLOT7,1010,630:PLOT7,1010,490:PLOT7,870,490:PLOT7,870,630
  140 MOVE477,285:PLOT7,477,315:MOVE477,515:PLOT7,477,485
  150 FORX=0TO4:MOVE(305+X),385:PLOT7,(305+X),389:NEXT
  160 MOVE890,630:PLOT7,940,700:PLOT7,990,630
  170 VDU4:VDU28,48,25,63,22:VDU5:GCOL0,0
  180 MOVE904,600:PRINT;"Home":MOVE900,570:PRINT;"Sweet"
  190 MOVE904,536:PRINT;"Home":VDU4:VDU28,48,25,63,22:GCOL0,1
  200 FORX=1TO9:MOVE(765+X),170:DRAW(765+X),100
  210   MOVE(1026+X),170:DRAW(1026+X),100
  220   MOVE(790+X),170:DRAW(790+X),110:MOVE(1045+X),180:DRAW(1045+X),110:NEXT
  230 GCOL0,1:MOVE750,160:DRAW750,350:PLOT85,1050,350:MOVE1060,360
  240 DRAW1060,170:PLOT85,750,160:PLOT85,1050,160:GCOL0,0
  250 MOVE1050,160:DRAW750,160:DRAW750,350:DRAW760,360
  260 DRAW1060,360:DRAW1060,170:DRAW1050,160:DRAW1050,350
  270 DRAW750,350:MOVE1050,350:DRAW1060,360
  280 CLS:PRINT"      The"'"    Space"'"   Programme"
  290 PRINT"   PRESS  'H'";:VDU5
  300 REPEAT:UNTILGET=ASC("H")
  310  MOVE0,0:!877=0:GCOL0,1:PROCclear
  320 VDU24,&02,&03,&C3,&00,&00,&04,&3E,&01
  330 PROCtakeoff
  340 PROCinflight
  350 PROCmoonland
  360 PROCinflight
  370 PROCre_entry
  380 PROCsplash
  390 CLS:VDU5:GCOL0,1:MOVE865,280:PRINT"THE":MOVE865,245:PRINT"END"
  400 VDU4:VDU28,0,31,79,0
  410 *FX15,0
  420 END
  430 DEF PROCclear:FORX=771 TO 1024 STEP2:MOVEX,195:PLOT7,X,318
  440   MOVE(X+1),195:DRAW(X+1),318:NEXT :ENDPROC
  450 DEF PROCre_entry
  460 VDU5:GCOL0,1:MOVE770,318:PRINT;"Re-entry"
  470 K=20:L=256:M=895
  480 FORX=0TO360 STEP10
  490   A=SINRAD(X):B=COSRAD(X)
  500   MOVEM,L:DRAW (A*K+M),(B*K+L)
  510   NEXT
  520 K=60
  530 X=0:REPEAT:X=X+8
  540   A=SINRAD(X)*K+M:B=COSRAD(X)*K+L
  550   MOVEA,B:DRAW(A+2),(B+2):DRAW(A-2),B
  560   PROCwait(0.15)
  570   MOVEA,B:PLOT7,(A+2),(B+2):PLOT7,(A-2),B
  580   K=K*0.97
  590   SOUND1,-15,RND(255),1:UNTILX>=305
  600 ENDPROC
  610 DEF PROCwait(s)
  620 LOCAL D
  630 D=TIME+(100*s)
  640 REPEAT:UNTILTIME=D
  650 ENDPROC
  660 DEF PROCtakeoff:VDU5:MOVE895,250:PRINT;"N.A.S.A."
  670 FORX=806TO808:MOVEX,195:DRAWX,256:NEXT:MOVE808,245:DRAW812,245
  680 MOVE820,195:DRAW830,260:PLOT85,840,195:FORX=10TO0 STEP -1
  690   PROCwait(1):MOVE770,305:PRINT"  ";CHR$127;CHR$127;X:NEXT
  700 FORX=0TO250 STEP4:GCOL0,1:MOVE820,(195+X):DRAW830,(260+X)
  710   PLOT85,840,(195+X):SOUND0,-15,100,2
  720   GCOL0,0:MOVE820,(195+X):PLOT7,830,(260+X):PLOT85,840,(195+X)
  730   NEXT
  740 ENDPROC
  750 DEF PROCinflight
  760 CLS:VDU5
  770 FORX=770TO1024 STEP5
  780   GCOL0,1:MOVEX,235:DRAW(X+70),250:PLOT85,X,265
  790   SOUND0,-15,100,3
  800   GCOL0,0:MOVEX,235:PLOT7,(X+70),250:PLOT85,X,265:NEXT
  810 ENDPROC
  820 DEF PROCmoonland
  830 GCOL0,1:FORX=-27TO27 STEP0.8:MOVE895,165
  840   DRAW(SINRAD(X)*300+895),(COSRAD(X)*300-70):SOUND0,-15,100,1:NEXT
  850 VDU5:MOVE850,215:GCOL0,0:PRINT"MOON":FORX=320TO225 STEP-2
  860   GCOL0,0:MOVE870,(X+2):DRAW870,(X+22):PLOT85,890,(X+22)
  870   DRAW890,X:PLOT85,870,(X+22):GCOL0,1:MOVE870,X:DRAW870,(X+20)
  880   PLOT85,890,(X+20):DRAW890,X:PLOT85,870,(X+20)
  890   SOUND1,-15,100,1:NEXT
  900 PROCwait(4):FORX=235TO320 STEP2
  910   GCOL0,1:MOVE870,X:DRAW870,(X+20):PLOT85,890,(X+20)
  920   DRAW890,X:PLOT85,870,(X+20):GCOL0,0:MOVE870,(X-2)
  930   DRAW870,(X+18):PLOT85,890,(X+18):DRAW890,X:PLOT85,870,(X+18)
  940   SOUND1,-15,100,1:NEXT
  950 ENDPROC
  960 DEF PROCsplash
  970 CLS:FORY=200TO216 STEP16:MOVE770,Y
  980   FORX=770TO1020:H=SINRAD((X-770)*20)*6+Y:DRAWX,H:NEXT:NEXT
  990 VDU5:MOVE925,280:PRINT"NASA":MOVE925,255:PRINT"rescue"
 1000 FORX=470TO220STEP-2:GCOL0,0:MOVE870,(X+2):DRAW870,(X+22)
 1010   PLOT85,890,(X+22):DRAW890,X:PLOT85,870,(X+22)
 1020   GCOL0,1:MOVE870,X:DRAW870,(X+20):PLOT85,890,(X+20)
 1030   DRAW890,X:PLOT85,870,(X+20):SOUND1,-15,(X-222),2:NEXT
 1040 FORX=0TO90 STEP8:A=(SINRAD(X-90)*100+895):B=(SINRAD(90-X)*100+895)
 1050   C=(COSRAD(X-90)*100+220):D=(COSRAD(90-X)*100+220)
 1060   MOVEA,C:DRAW895,220:DRAWB,D:SOUND0,-13,102,4:NEXT
 1070 PROCwait(5):ENDPROC
```

Grid of design

Bill Longley,
Colchester,
Essex.

SPECTRUM

PROGRAMMING THE user-definable graphics on a ZX Spectrum is not as easy as some would have you believe. For each character, a total of eight Pokes are needed. Also, you need to work out the design on a piece of paper beforehand, and then convert to binary.

This program makes both tasks much simpler. You decide the key you want the graphic to be on — any of the letters from A to U — and enter it in response to the prompt. Then you can enter the design on a grid on the screen. The usual cursor keys move the flashing cursor over the grid — you cannot move out of it — while 1 and 2 enter or erase a point respectively. Finally, pressing 0 enters the graphic into the character set.

The first thing you see on running the program are the instructions, which can be ignored by pressing any key. There are several separate routines in the program. These are:

Lines 10 to 20: these set up the variables and call the instructions.

Lines 30 to 50: these draw the grid on the screen.

Line 60: clears the array holding the character information, and asks for the character.

Lines 100 to 160: move the cursor, fill in the appropriate spaces, and check if the zero key is pressed. If so, the character-setting routine is called.

Lines 500 to 540: find out if another graphic is wanted. If so, run again; if not, stop.

Lines 1000 to 1030: instructions.

Lines 2000 to 2070: enter the graphic into the character set. If this is changed to suit your machine, the rest of the program can be changed easily to fit a BBC Micro, Vic-20, or another micro with programmable characters.

Note lines 20, 150, 530 and 2070 are acceptable in Sinclair Basic, but the variables would have to be entered in lower case to work on a BBC, and on other micros, changed to normal numbers. I use this trick to make programs more readable, and hope that others will take up the idea. *(continued on next page)*

(continued from previous page)

```
   1 REM    CHARACTER GENERATOR
   2 REM       for ZX Spectrum
   3 REM    © Bill Longley 1982
   4 REM
  10 LET x=8: LET y=8: LET DEFIN
E CHARACTER=30: LET NEXT CHARACT
ER=500: LET INSTRUCTIONS=1000: L
ET SET CHARACTER=2000
  20 GO SUB INSTRUCTIONS
  30 CLS : PLOT 63,112: DRAW 65,
0: DRAW 0,-65: DRAW -65,0: DRAW
0,65
  40 FOR g=63 TO 128 STEP 8: PLO
T g,112: DRAW 0,3: PLOT g,47: DR
AW 0,-3: NEXT g
  50 FOR g=47 TO 112 STEP 8: PLO
T 63,g: DRAW -3,0: PLOT 128,g: D
RAW 3,0: NEXT g
  60 DIM K(8,8): INPUT "Graphic
to be programmed? ";P$
 100 LET X$=SCREEN$ (x,y): PRINT
 AT x,y; PAPER 6;" ": PAUSE 8: P
RINT AT x,y; PAPER 7;x$
 110 IF INKEY$="1" THEN PRINT AT
 x,y; INK 0;"X": LET K(X-7,Y-7) =
2
 120 IF INKEY$="2" THEN PRINT AT
 x,y; INK 0;" ": LET K(X-7,Y-7) =
0
 130 LET X=X+(INKEY$="6" AND X<1
5)-(INKEY$="7" AND X>8)
 140 LET Y=Y+(INKEY$="8" AND Y<1
5)-(INKEY$="5" AND Y>8)
 150 IF INKEY$="0" THEN GO TO SE
T CHARACTER
 160 GO TO 100
 500 CLS : PRINT TAB 6;"CHARACTE
R PROGRAMMED.";AT 20,0;"Another?
"
 510 INPUT "(Y/N)   ";S$
 520 IF S$="N" OR S$="n" THEN ST
OP
 530 IF S$="Y" OR s$="y" THEN GO
 TO DEFINE CHARACTER
 540 INPUT "Y OR N!!!!!";S$; GO
TO 520
1000 PRINT TAB 4;"USER DEFINED G
RAPHICS."
1010 PRINT '''"          When you ha
ve read these  instructions,pres
sing any key    will draw a grid
in the centre   of the screen."''
"  You can then enter the graphi
ccharacter you want to program,
 and then you draw the graphic o
nthe grid.The cursor is moved
 using the arrowed keys;to fill
 a square,press 1,to empty it,
 press 2.Pressing 0 sets the
 design in the memory."
1020 IF INKEY$="" THEN GO TO 102
0
1030 CLS : RETURN
2000 PRINT AT 20,0;"Programming
this graphic:"
2005 FOR G=1 TO 8
2010 LET A=0
2020 FOR H=1 TO 8
2035 IF k(g,h)<>0 THEN LET A=A+K
(G,H)↑INT (8-H)
2040 NEXT H
2050 POKE USR P$+G-1,A
2060 NEXT G
2070 GO TO NEXT CHARACTER
```

Lower case

Brian Cadge,
Yardley,
Birmingham.

ZX-81

My program for the 16K ZX-81 extends the character set of the printer to upper- and lower-case letters, plus the additional characters ! and & and %. Before typing it in, you should change RAMtop to 31744, by Poking 16389,124 and 16388,0.

The main body of the program is used in initialising the array of L$, which holds the characters. There is still plenty of memory left after this program if you want to use it as part of a main program. Line 90 shows how to incorporate it into a larger program.

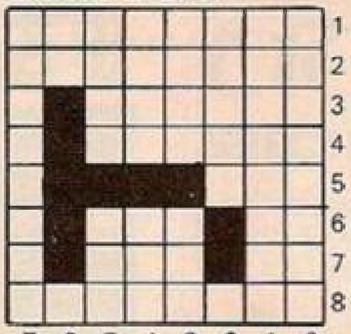
When using the program the following characters are allowed:

CHR$ 0 to 63: normal symbols and alphanumerics
Inverse video A to Z for lower case a to z; to the power of ; %; and !
AND: shifted 2 for &

Each element in the array of L$ is one character and each is eight characters long. As you may find some confusion about which character is being used in the listing here is an alternative set out of the codes of the characters used in tabular form.

Finally, you may be forgiven for thinking that this program is rather laborious to enter. However, as you can see, the results are well worth it. Also by creating your own characters, a whole new field of uses for the ZX-81 and printer reveals itself.

Character in L$(8)



If we take for example the letter h, the numbers vertically, 1 to 8, are the character positions in the element of the L$ array. The numbers along the bottom, 7 to 0, represent the dot above of each column. We raise 2 to the power of this number if we want the dot to be on, and sum the numbers for each row to give the character. Thus, for h:

CHR number	Code
1	0
2	0
3	2^6 : 64
4	2^6 : 64
5	$2^6 + 2^5 + 2^4 + 2^3$: 120
6	$2^6 + 2^2$: 68
7	$2^6 + 2^2$: 68
8	0

Characters used in L$ array.

Array number	Codes of characters used:							
1	0	0	56	4	60	68	60	0
2	0	0	64	64	120	68	120	0
3	0	0	0	60	64	64	60	0
4	0	0	4	4	60	68	60	0
5	0	0	56	68	124	64	56	0
6	0	24	32	32	112	32	32	0
7	0	0	56	68	60	4	56	0
8	0	0	64	64	120	68	68	0
9	0	16	0	16	16	16	16	0
10	0	8	0	8	8	8	112	0
11	0	64	72	80	96	80	72	0
12	0	16	16	16	16	16	16	0
13	0	0	40	84	84	84	84	0
14	0	0	0	24	36	36	36	0
15	0	0	56	68	68	68	56	0
16	0	0	56	68	120	64	64	0
17	0	0	56	68	68	124	4	0
18	0	0	0	28	32	32	32	0
19	0	0	56	64	56	4	56	0
20	0	0	32	112	32	36	24	0
21	0	0	0	36	36	36	24	0
22	0	0	0	68	68	40	16	0
23	0	0	0	130	146	170	68	0
24	0	0	68	40	16	40	68	0
25	0	0	68	40	16	32	64	0
26	0	0	56	8	16	32	56	0
94	0	48	72	48	52	72	52	0
95	0	0	100	104	16	44	76	0
96	0	16	16	16	16	0	16	0

L$ 27 to 93 are copied from the ROM by the program itself.

```
   1 REM LOWER-CASE LETTERS
         PROGRAM BY BRIAN CADGE
   2 IF NOT (PEEK 16388+256*PEEK
16389=31744) THEN STOP
   3 REM COPY LPRINT ROUTINE
         FROM R.O.M.
   4 FAST
   5 FOR I=0 TO 112
   6 POKE 31744+I,PEEK (2161+I)
   7 NEXT I
   8 POKE 31800,63
   9 POKE 31857,201
  10 DIM A$(32,8)
  11 GOTO 24
  12 REM SUBROUTINE TO PRINT
         FILL PRINTER-BUFFER AND
         PRINT OUT CHARACTERS
  13 FOR I=1 TO 32
  14 FOR J=1 TO 8
  15 POKE 32255+J+8*(I-1),CODE A
$(I,J)
  16 NEXT J
  17 NEXT I
  18 REM FILL BUFFER
  19 FOR I=1 TO 32
  20 POKE 16443+I,I-1
  21 NEXT I
  22 LET PRINTOUT=USR 31744
  23 RETURN
  24 DIM L$(96,8)
  25 LET L$(1)="  S,U"+CHR$ 68+"
U "
  26 LET L$(2)="  RNDRND"+CHR$ 1
20+CHR$ 68+CHR$ 120+CHR$ 0
  27 LET L$(3)="   URNDRNDU "
  28 LET L$(4)="   "+CHR$ 4+CHR$
4+"U"+CHR$ 68+"U "
  29 LET L$(5)="  S"+CHR$ 68+CHR
$ 124+"RNDS "
```

```
  30 LET L$(6)=" /44"+CHR$ 112+"
44 "
  31 LET L$(7)="  5"+CHR$ 68+"W.
5 "
  32 LET L$(8)="  RNDRND"+CHR$ 1
20+CHR$ 68+CHR$ 68+CHR$ 0
  33 LET L$(9)=" + ((((  "
  34 LET L$(10)=" "+CHR$ 8+" "+C
HR$ 8+CHR$ 8+CHR$ 8+CHR$ 112+CHR
$ 0
  35 LET L$(11)=" RND"+CHR$ 72+C
HR$ 80+CHR$ 96+CHR$ 80+CHR$ 72+"
 "
  36 LET L$(12)=" (((((( "
  37 LET L$(13)="  C"+CHR$ 84+CH
R$ 84+CHR$ 84+CHR$ 84+" "
  38 LET L$(14)="   /888 "
  39 LET L$(15)="  S"+CHR$ 68+CH
R$ 68+CHR$ 68+"S "
  40 LET L$(16)="  S"+CHR$ 68+CH
R$ 120+"RNDRND "
  41 LET L$(17)="  S"+CHR$ 68+CH
R$ 68+CHR$ 124+"  "
  42 LET L$(18)="   0444 "
  43 LET L$(19)="  SRNDS. 5 "
  44 LET L$(20)="  4"+CHR$ 112+"
46/ "
  45 LET L$(21)="   888/ "
  46 LET L$(22)="  "+CHR$ 68+CH
R$ 68+"C( "
  47 LET L$(23)="  ▄▄▄"+CHR$ 68
+" "
  48 LET L$(24)="  "+CHR$ 68+"C(
C"+CHR$ 68+" "
  49 LET L$(25)="  "+CHR$ 68+"C(
4RND "
  50 LET L$(26)="  S"+CHR$ 8+"(4
S "
  51 LET L$(94)=" K"+CHR$ 72+"KO
"+CHR$ 72+"O "
  52 LET L$(95)="  "+CHR$ 100+CH
R$ 104+"(G"+CHR$ 76+" "
  53 LET L$(96)=" (((( ( "
  54 REM COPY CHR$ 0 TO 63 FROM
         R.O.M. AND PUT INTO L$
  55 FOR I=0 TO 63
  56 LET K$=""
  57 FOR J=0 TO 7 STEP 2
  58 LET K$=K$+CHR$ (PEEK (7680+
I*8+J))+CHR$ (PEEK (7680+I*8+J+1
))
  59 NEXT J
  60 LET L$(30+I)=K$
  61 NEXT I
  62 SLOW
  63 REM PROGRAM TO CONVERT
         MESSAGE IN Z$ TO UPPER
         AND LOWER CASE LETTERS
  64 PRINT "THIS PROGRAM PRINTS
ONE LINE AT A TIME.USE THE FOLLO
WING :","NORMAL CHARACTERS 0 TO
63 FOR  NORMAL PRINT-OUT","INVE
RSE VIDEO ▒ TO ▒ FOR LOWER  CASE
",,"** (TO THE POWER OF) FOR PER
CENTSIGN",,"▒ FOR EXCLAMATION MA
RK"," AND (SHIFTED 2) FOR AND SI
GN"
  65 PRINT
  66 DIM Z$(32)
  67 PRINT "TYPE IN SENTENCE?"
  68 INPUT Z$
  69 IF Z$(1)=" STOP " THEN STOP
  70 FAST
  71 FOR I=1 TO 32
  72 IF Z$(I)=CHR$ 218 OR Z$(I)=
CHR$ 216 OR Z$(I)="▒" THEN GOTO
85
  73 IF Z$(I)="█" THEN GOTO 83
  74 IF CODE Z$(I)<64 THEN GOTO
81
  75 IF CODE Z$(I)>191 OR CODE Z
$(I)<166 THEN GOTO 83
  76 LET A$(I)=L$(CODE Z$(I)-165
)
  77 NEXT I
  78 GOSUB 13
  79 SLOW
  80 GOTO 68
  81 LET A$(I)=L$(CODE Z$(I)+30)
  82 GOTO 77
  83 LET A$(I)="
  84 GOTO 77
  85 IF Z$(I)=CHR$ 218 THEN LET
A$(I)=L$(94)
  86 IF Z$(I)=CHR$ 216 THEN LET
A$(I)=L$(95)
  87 IF Z$(I)="▒" THEN LET A$(I)
=L$(96)
  88 GOTO 77
  89 REM
  90 REM IF YOU WANT TO USE THIS
         AS PART OF A MAIN PROGRAM
         THEN CHANGE LINE 64 TO GOTO
         FIRST LINE NO.,LINE 80 TO
         RETURN AND USE GOSUB 70 TO
         PRINT OUT MESSAGE IN Z$
         WHICH MUST HAVE BEEN
         DIM Z$(32) BEFORE.
```

Automatic Rem

K Young, Watford, Hertfordshire.

ZX-81

WHEN USING machine code on a ZX-81, it is usual to put the code in a Rem statement. If a long Rem statement is required and one is not available on tape, you must type one in from the keyboard. This soon becomes tedious and time-consuming as, even in fast mode, the ZX-81 slows down considerably as the line length increases.

The program enables a large Rem to be created quickly. In use any long program is loaded from tape, and then appended with line 1 and lines 9000 to 9120. Goto 9000 is typed to run the program, which expands the Rem of line 1.

```
1 REM EXPANDER
9000 PRINT "HOW MANY BYTES REQUIRED?"
9010 INPUT N
9020 LET L1 = PEEK 16511 + 256*PEEK 16512
9030 LET L2 = PEEK (L1 + 16515) + 256*PEEK
     (L1 + 16516)
9040 LET L3 = L1 + L2 + 4
9050 LET X = INT (L3/256)
9060 POKE 16511,L3-256*X
9070 POKE 16512,X
9080 POKE L1 + 16512,0
9090 IF L1 + L2 + 2<N THEN GOTO 9020
9100 POKE 16514,118
9110 POKE 16515,118
9120 PRINT "REM LENGTH =";L3-2;"BYTES"
```

If you attempt to create too large a Rem, then the expander program is over-written, causing an error before completion. If no suitably large program is available on tape, or no tape recorder available, then the following procedure can be used.

Type in or load the expander program, type in a short Rem in line 1, edit this to give an identical line 2, run the expander typing 1 at the input. This effectively doubles the length of line 1, and the procedure may be repeated, doubling the length of the Rem every time.

Filing point

S A Nicholls, Keynsham, Bristol.

ZX-81

THIS SHORT machine-code program may be of use to all ZX-81 owners who, like myself, have less than 3.25K RAM, and wish to set up a display file without using up too much of their precious RAM. A 22-line by 32-column file is set up in about two seconds, and uses about half the memory of its Basic counterpart.

The program is entered direct from the keyboard and can be edited to give any size and character display. I have underlined any keywords used and all but Clear and Pause can be entered directly. To enter Clear and Pause first type Then Clear and Then Pause and using Rubout delete the word Then in each case.

```
1 REM :-▒4Y█ NOT ( CLEAR YV * NOT $ 4 PAUSE TAN
2 RAND USR VAL "16514"
TO CHANGE PARAMETERS          POKE 16515, Lines required.
                              POKE 16517, Columns required.
                              POKE 16519, Code of background
                                          character required.
 0E 16            LD C,22     Lines.
 06 20   NEXT     LD B,32     Columns.
 3E 80            LD A,128    Black character.
 D7      PRINT    RST 10      Print a character.
 10 FD            DJNZ PRINT  Print a line.
 3E 3B            LD A,59     Load A with 59 and
 17               RLA         multiply by 2
                              (LD A,118 not available from keyboard
                              and would corrupt LISTING of BASIC
                              program.)
 D7               RST 10      Print newline character
 0C               DEC C       Reduce lines by one.
 20 F2            JRNZ NEXT   If lines not zero then print next line.
 C9               RET         Return to basic.
```

Multiple response

John Wilkinson, Chesterfield, Derbyshire.

GENIE

I WROTE this small program on a Genie which allows statements such as

Z$ = Z$ + T$

This will need changing for other Basics. The aim of the program is to provide a multiple-character response to a single keystroke which I find very useful when using Impakt and LDOS.

Other features that could be added are a routine to change the phrases called during running time; a help call to display the phrases available and perhaps graphics.

```
10 REM MULTIKEY - MULTIPLE REPLY SUBPROG BY JOHN WILKINSON  21 WHEATCROFT CLOSE
DANESMOOR CHESTERFIELD DERBYSHIRE
20 CLEAR 256
30 READ NT:DIM Z$(NT)
40 FOR N=1TO NT
50      READ Z$(N):              REM SUB ROUTINE DATA LOADING
60 NEXT N
70 CLS :                         REM DEMO PROG
80 PRINT"TYPE IN  ANYTHING AND CALL LONG PHRASES BY USING            A BACK
SLASH (DIVISION SIGN) THEN THE CALL LETTER."
90 FOR C=1TO40
100          GOSUB 140 :          REM INPUT SUB ROUTINE
110          PRINTA$;
120 NEXT C
130 REM SUBROUTINE FOR KEY INPUTS
140 PRINTCHR$(95);:              REM PREVENTS A BACKSPACE ON
                                  THE FIRST KEY INPUT
150 Z$=INKEY$ :                     REM GET A SINGLE CHARACTER
160 IF Z$=""THEN 150
170 IF Z$=CHR$(47)THEN GOTO 280 :  REM 32=DIVIDE. OTHER CODES COUD BE USED
180 PRINTCHR$(24);:                REMOVE LAST CURSOR PRINTED
190 PRINTZ$;
200 PRINTCHR$(95);
```

(continued on next page)

(continued from previous page)

```
210 T$=T$+Z$ :                    REM BUILD TEMPORARY STRING
220 IF Z$=CHR$(13) THEN 240 :     REM TEST FOR END OF WORD
230 GOTO150 :                     REM GET ANOTHER CHARACTER
240 A$=T$:T$="":                  REM GIVES TEMP.STRING TO A$
250 PRINTCHR$(24);:               REMOVE LAST CURSOR PRINTED
260 RETURN :                      'AND CLEARS TEMP.STRING
270 REM MULTIPLE REPLY SUB ROUTINE
280 PRINTCHR$(24);:               REMOVE LAST CURSOR PRINTED
290 M$=INKEY$ :                   REM GET THE CALL KEY
300 IF M$=""THEN 290
310 IF ASC(M$)<65 OR ASC(M$)>90 THEN 290
320 REM THIS LINE CHECKS THE CALL KEY IS WITHIN CHOSEN LIMITS
330 REM THESE COULD BE WIDENED TO INCLUDE CHR$ ABOVE OR BELOW
340 REM THE ALPHABET EG CHR$(63)=? THE FULL 10 NUMBERS COULD
350 REM ALSO BE INCLUDED IN ANOTHER AND/OR CLAUSE
360 N=ASC(M$)-64 :            REM FIND THE RIGHT CALL INDEX NO.
370 Z$ = Z$(N): REM GIVES THE CALL STRING TO THE PROG VARIABLE
380 GOTO190
390 REM

                 DATA SECTION
400 DATA 26:REM AMOUNT OF MULTIPLE CHARACTERS AVAILABLE TO CALL
410 DATA A LONG WORD, BE GOOD TODAY, CHOOSE CAREFULLY, DONT PUSH YOUR LUCK, " EV
ERY ONE DIDN'T , DID YOU", FREE AT LAST, GOT YOU NOW, HAVE YOU ANY , I DONT KNOW
, JUST WAIT AND SEE, KILL THAT BUG!!!, LOST AND FOUND, MY HOW YOUVE GROWN
420 DATA  NO THANK YOU, OPEN SUNDAYS, PLEASE, QUEUE THIS SIDE ONLY,REST IN PEACE
,STOP THAT AT ONCE,THANKYOU VERY MUCH,USUALLY I EAT ALONE,VERY WELL THANK YOU,WI
LL YOU CALL AGAIN,XYLOPHONE,YOU SHOULD SEE WHAT HE HAS,ZOO
1000 REM
         MINIMUM PROGRAM LISTING FOR QUICK TYPING IN.
1010 CLEAR256:READNT:DIMZ$(NT):FORN=1TONT:READZ$(N):NEXTN:CLS:PRINT"TYPE IN  ANY
THING AND CALL LONG PHRASES BY USING             A BACK SLASH (DIVISION SIGN)
 THEN THE CALL LETTER.":FORC=1TO40:GOSUB1011:PRINTA$;:NEXTC
1011 PRINTCHR$(95);
1012 Z$=INKEY$:IFZ$=""THEN1012
1013 IFZ$=CHR$(47)THEN1018
1014 PRINTCHR$(24);
1015 PRINTZ$;:PRINTCHR$(95);:T$=T$+Z$:IFZ$=CHR$(13)THEN1017
1016 GOTO1012
1017 A$=T$:T$="":PRINTCHR$(24);:RETURN
1018 PRINTCHR$(24);
1019 M$=INKEY$:IFM$=""THEN1019
1020 IFASC(M$)<65ORASC(M$)>90THEN1019
1021 N=ASC(M$)-64:Z$=Z$(N):GOTO1015:DATA26
1022 DATAA LONG WORD,BE GOOD TODAY,CHOOSE CAREFULLY,DONT PUSH YOUR LUCK," EVERY
ONE DIDN'T , DID YOU",FREE AT LAST,GOT YOU NOW,HAVE YOU ANY,I DONT KNOW,JUST WAI
T AND SEE,KILL THAT BUG!!!,LOST AND FOUND,MY HOW YOUVE GROWN
1023 DATANO THANK YOU,OPEN SUNDAYS,PLEASE,QUEUE THIS SIDE ONLY,REST IN PEACE,STO
P THAT AT ONCE,THANKYOU VERY MUCH,USUALLY I EAT ALONE,VERY WELL THANK YOU,WILL Y
OU CALL AGAIN,XYLOPHONE,YOU SHOULD SEE WHAT HE HAS,ZOO
```

Course of shots

N R Civeton,
Bishops Stortford,
Hertfordshire.

SPECTRUM

GOLF, WRITTEN for the ZX Spectrum, is great fun to play. I used the ATTR function to work out what was in any particular square. So, if you want to change either the Paper or Ink, or perhaps stop something flashing or brightening the screen, all the ATTR numbers will have to be changed accordingly.

The program asks you the direction, which can be anything from 0 to 12. Direction 0 is straight up, 3 is to the right, 6 down, and 9 left. You then input strength on a 0 to 200 scale, depending on the distance of hole. If your ball falls into a bunker, do not despair; the computer will chip it out — but in a random direction.

```
   1 POKE USR "a",BIN 00001000: POKE USR "a"+1,BIN 00011100: POKE USR "a"+2,BIN 00101010: POKE USR "a"+3,BIN 00011100: POKE USR "a"+4,BIN 00101010: POKE USR "a"+5,BIN 00001000: POKE USR "a"+6,BIN 00001000: POKE USR "a"+7,BIN 00001000
   2 POKE USR "b",BIN 00101000: POKE USR "b"+1,BIN 11010110: POKE USR "b"+2,BIN 00000001: POKE USR "b"+3,BIN 01110000: POKE USR "b"+4,BIN 10001101: POKE USR "b"+5,BIN 00100010: POKE USR "b"+6,BIN 11010001: POKE USR "b"+7,BIN 00001110
   3 POKE USR "c",BIN 00110011: POKE USR "c"+1,BIN 11001100: POKE USR "c"+2,BIN 00110011: POKE USR "c"+3,BIN 11001100: POKE USR "c"+4,BIN 00110011: POKE USR "c"+5,BIN 11001100: POKE USR "c"+6,BIN 00110011: POKE USR "c"+7,BIN 11001100
   4 PAPER 6
   5 BEEP .5,15: BEEP .5,15
   6 POKE 23609,150
   9 GO TO 100
  10 LET l=LEN a$
  20 FOR i=0 TO (y1-l)*s1*f/l
  30 PRINT AT x1*RND+x0,y0+(y1-l)*RND; INK klo;a$
  40 NEXT i
  45 BEEP .1,20: BEEP .1,20: BEEP .1,20
  50 RETURN
 100 PRINT INK 2;" Enter number of holes you wish to play"
 110 PRINT INK 1;AT 3,6;"9 for a short game"
 120 PRINT INK 1;AT 6,6;"18 for a long game"
 130 INPUT gl
 140 IF gl<>18 AND gl<>9 THEN GO TO 130
 150 CLS
 160 PRINT INK 2;"Enter handicap"
 170 PRINT INK 1;AT 3,5;"1)=Expert";AT 6,5;"2)=Average";AT 9,5;"3)=Duffer"
 200 INPUT hc
 210 IF hc<1 OR hc>3 THEN GO TO 200
 220 LET hc=hc-2
 500 LET p6=PI/6
 510 LET course par=0
 530 LET hole=0
 535 LET green=3e3
 540 LET bunker=3500
 545 LET trees=4e3
 550 LET lake=4500
 555 LET rough=5e3
 565 LET ruf=0
 570 LET k$="
                                 "
 600 LET par=INT (3+3*RND)
 610 LET shots=0
 620 LET yards=10*INT (10*(par-2*RND))
 622 LET s1=32/yards
 625 LET hole=hole+1
 630 LET o$="T"
 640 CLS
 650 LET par=par+hc
1000 FOR i=0 TO 21: PRINT INK 5;"▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀▀";: BEEP .1,25: NEXT i
1005 GO TO 1105
1030 FOR i=2 TO 28 STEP 2
1040 LET l=5+5*RND
1060 FOR j=l TO 11+5*RND
1070 PRINT INK 4;AT j,i;"▓▓";
1080 NEXT j
1090 NEXT i
1095 BEEP .5,10: BEEP .5,10
1100 GO TO 1205
1105 LET f=50
1130 LET y1=3
1140 LET x0=0
1150 LET x1=20
1155 LET klo=0
1160 LET a$="$"
1170 FOR z=1 TO 2
1180 LET y0=5+20*RND
1190 GO SUB 10
1200 NEXT z
1202 GO TO 1255
1205 LET x0=3: LET y0=2: LET x1=15: LET y1=25: LET klo=7: LET a$="...": LET f=4: GO SUB 10
1250 GO TO 1270
1255 LET a$="$"
1256 LET klo=0
1260 LET f=50
1265 GO SUB 10
1268 GO TO 1030
1270 FOR z=1 TO 2
1280 LET x0=INT (15*RND+1)
1290 LET y0=20*RND+5
1300 FOR i=x0 TO x0+2+2*RND
1320 LET y1=y0+2*RND
1340 PRINT INK 1;AT i,y1;"▓▓▓▓▓▓"( TO 2+4*RND)
1350 NEXT i: BEEP .1,RND*10: NEXT z
1380 LET holex=INT (3+15*RND)
1400 FOR i=1 TO 5
1410 PRINT INK 6;AT (holex-3)+i,26;"     "
1420 NEXT i
1430 PRINT AT 0,13;"HOLE";hole;AT holex,29; INK 2; FLASH 1;"H"
1435 LET ph=INT (RND*14+3): LET ballx=ph: LET bally=2
1470 PRINT AT 0,0;yards;"YDS";AT 0,27;"PAR";par
1500 PRINT INK 3;AT ph,2;"T"
1501 PAUSE 15
1502 PRINT INK 3;AT ph,2;"t"
1505 PAUSE 15
1510 IF INKEY$="" THEN GO TO 1500
1515 PRINT AT 21,0;k$;AT 21,0;"Direction(0 TO 12)?"
1520 INPUT ang
1525 IF ang>12 THEN GO TO 1520
1530 LET ang=ang*p6
1540 PRINT AT 21,0;k$;AT 21,0;"Strength(0 TO 200)?"
1550 INPUT s
1560 PRINT AT 21,0;k$
1565 IF s>200 THEN LET s=200
1570 LET s=s*s1
1579 IF ruf THEN LET s=s/4
1581 IF o$="o" THEN PRINT AT ballx,bally; INK 4;"▓"
1582 IF o$="S" THEN PRINT AT ballx,bally; INK 1;o$
1583 IF o$="$" THEN PRINT AT ballx,bally; INK 0;o$
1584 IF o$="lop" THEN PRINT AT ballx,bally; INK 5;"█"
1585 IF o$="p" THEN PRINT AT ballx,bally; INK 6;"█"
1600 LET shots=shots+1
1610 LET ruf=0
1620 LET ballx=ballx-s*COS ang
1630 LET bally=bally+s*SIN ang
1635 IF ABS (ballx-10)<=10 AND ABS (bally-15.5)<=15.5 THEN GO TO 1700
1640 IF ballx<0 THEN LET ballx=0
1650 IF ballx>20 THEN LET ballx=20
1660 IF bally<0 THEN LET bally=0
1670 IF bally>31 THEN LET bally=31
1675 LET shots=shots+1
1680 PRINT AT 21,0;"Out of bounds-penalty shot";AT 0,22;shots
1700 IF ATTR (ballx,bally)=178 THEN GO TO 2100
1705 IF ATTR (ballx,bally)=54 THEN GO TO green
1710 IF ATTR (ballx,bally)=52 THEN GO TO 2e3
1720 IF ATTR (ballx,bally)=83 THEN GO TO rough
1730 IF ATTR (ballx,bally)=49 THEN GO TO lake
1740 IF ATTR (ballx,bally)=55 THEN GO TO bunker
1750 IF ATTR (ballx,bally)=48 THEN GO TO trees
1760 GO TO 1700
2000 LET bee=20: LET beep=20
2001 LET o$="o"
2004 PRINT AT 0,22;shots
2005 PRINT FLASH 1;AT ballx,bally;"B"
2006 BEEP .2,bee: BEEP .1,beep
2010 IF INKEY$="" THEN GO TO 2005
2020 GO TO 1515
2100 LET par=shots-par
2105 PRINT AT 3,12; INK 0;"HOLE ";hole;AT 6,8;"holed it in ";shots;" shots"
2110 IF shots=1 THEN PRINT FLASH 1; INK 3;AT 5,8;"***************";AT 7,8;"***************"
2115 IF NOT par THEN PRINT AT 9,8;"A par,well done"
2116 IF par=-1 THEN PRINT AT 9,6;"A birdie,not bad"
2117 IF par=-2 THEN PRINT AT 9,2;"My God...a great big eagle."
2118 IF par=-3 THEN PRINT AT 9,8;"An albatros,superb"
2120 IF par=-4 THEN PRINT AT 9,0;"4 under,I don't know what that   is,a Dodo perhaps!!!"
2121 IF par>0 THEN PRINT AT 9,12;par;" over"
2122 LET course par=course par+par: PRINT AT 12,8;"Overall ";
2123 IF course par THEN GO TO 2130
2124 PRINT "on par"
2125 GO TO 2140
2130 PRINT ABS course par;
2135 IF course par<0 THEN PRINT " Under par"
2136 IF course par>0 THEN PRINT " Over par"
2140 IF hole>=gl THEN GO TO 2500
2142 FOR i=1 TO 15
2143 BEEP .1,i
2144 NEXT i
2145 PAUSE 100
2150 GO TO 600
2500 FOR i=20 TO -20 STEP -1
2502 BEEP .01,i: NEXT i
2504 BEEP .1,20: PAUSE 5: BEEP .1,20
2508 PRINT AT 19,0;"End of game,have a pint at the  nineteenth or press""ENTER"" to   start again"
2509 IF course par<=7 THEN PRINT AT 15,1;"Your handicap is suspiciously  low,better change it tie around"
2510 INPUT "Again?",a$
2520 IF a$="" THEN RUN
2530 STOP
3000 PRINT AT 21,0;k$;AT 21,0;"On the green in ";shots
3005 LET o$="p"
3010 GO TO 2004
3500 PRINT AT 21,0;k$;AT 21,0;"Bunkered,a chip shot"
3505 PAUSE 20
3506 LET o$="."
3510 LET shots=shots+1
3520 GO SUB 3600
3530 PRINT AT ballx,bally; INK 7;".";AT 0,22;shots
3540 LET ballx=ballx+3*RND-1
3550 LET bally=bally+2*RND
3590 GO TO 1700
3600 FOR i=1 TO 10: BEEP .01,i: NEXT i
3610 RETURN
4000 PRINT AT 21,0;k$;AT 21,0;"In the trees-penalty shot"
4005 LET o$="$"
4010 LET shots=shots+1
4015 LET bee=25: LET beep=10
4020 GO TO 2004
4500 PRINT AT 21,0;k$;AT 21,0;"In the lake,penalty shot"
4505 LET o$="S"
4510 LET shots=shots+1
4515 LET bee=25: LET beep=10
4520 GO TO 2004
5000 PRINT AT 21,0;k$;AT 21,0;"In the rough-better hack it"
5005 LET o$="lop"
5010 LET ruf=1
5015 LET bee=10: LET beep=20
5020 GO TO 2004
5030 SAVE "golf"
5040 RUN
```

Windmills

S J Bennett,
Scarborough,
North Yorkshire.

ZX-81

YOU HAVE BEEN sent by your firm to an island in the Outer Hebrides. Your task is to build windmills in the most profitable areas of the island. For each mill you build, you receive one lorry to transport corn and coal, to and from the mill.

Try to build your mills in areas where the wind conditions are good, and therefore use less coal for the donkey engine. The maximum number of years you can stay on the island is 50. For each year you stay you are given a report of the cost of coal, petrol and other expenses. Be careful of the price you charge per bag of corn as the farmers may argue with you. When you decide to leave, you are shown the nett income for each year, and then a total for the full period on the island.

The island has been split into co-ordinates A to P inclusive, and 1 to 8 inclusive. To enter a mill, type number first, then letter. After entering your positions, you will be shown a display of weather conditions.

1	3P	Windswept Area
2	4A	Sheltered Area
3	6M	Windy Valley

The first column is the mill; the second column the location; and the third the weather conditions for that area. After the weather conditions, you can alter the locations of any of your mills, or ask for a report on mills already built.

Here are the variables used.

A	=	Control variable
B	=	Control variable
C	=	Coal used
H	=	Corn harvested
P	=	Petrol used
MW	=	Miller's wages
TA	=	Total expenses
AE	=	Charge per bag
YRT	=	Total years on island
TC	=	Total coal used
TP	=	Total petrol used
XX	=	Tax paid
ZA	=	Random number * 10
ZX	=	Gross earnings
D(B)	=	Distance variable
X(B)	=	Letter co-ordinate
Y(B)	=	Number co-ordinate
Z(B)	=	Co-ordinates of mills built

```
   1 DIM W(50)
   2 GOSUB 3000
   3 LET YR=1
   5 CLS
   6 PRINT AT 2,0;"WINDMILLS YEAR ";YR
   8 PRINT
  10 PRINT "HOW MANY MILLS WOULD YOU LIKE?"
  11 PRINT "(MAXIMUM NUMBER ALLOWED IS 10)"
  12 PRINT AT 7,0;"YOU MUST ENTER A NUMBER FOR 1ST"
  13 PRINT "YEAR. FOR 2ND YEAR ONWARDS, YOU CAN ENTER ZERO TO RETAIN THE    ORIGINAL NUMBER YOU STARTED WITH"
  15 INPUT B
  16 CLS
  17 IF YR<=1 AND B=0 THEN GOTO 5
  18 IF B>=11 THEN PRINT "NOT ENOUGH SPACE FOR ";B;" MILLS"
  20 IF B>=11 THEN FOR I=1 TO 100
  21 IF B>=11 THEN NEXT I
  22 IF B>=11 THEN GOTO 5
  24 LET TC=0
  26 LET TP=0
  28 IF YR>=2 AND B=0 THEN GOTO 250
  30 LET A=B
  55 PRINT AT 4,0;"ENTER LOCATION; NUMBER FIRST"
  57 PRINT "THEN LETTER. EXAMPLE 3F"
  60 PRINT
  70 DIM D(B)
  73 DIM X(B)
  75 DIM Y(B)
  80 DIM Z(B)
  90 DIM Z$(B,2)
  95 FOR B=1 TO A
 100 GOSUB 2000
 110 PRINT A$;" ";
 115 NEXT B
 150 PRINT AT 9,0;"PRESS NEW LINE WHEN READY"
 160 INPUT B$
 170 CLS
 173 IF B$="R" THEN GOTO 400
 175 IF CODE B$=51 OR B$="" THEN GOTO 250
 180 PRINT AT 13,0;"ENTER THE NUMBER OF"
 185 PRINT "THE MILL TO BE ALTERED"
 190 INPUT B
 195 CLS
 205 PRINT AT 13,0;"ENTER NEW LOCATION"
 225 GOSUB 2000
 230 PRINT AT 13,0;"TYPE .A. TO ALTER LOCATION  OR"
 231 PRINT
 232 PRINT "NEW LINE FOR WEATHER CONDITIONS"
 234 INPUT B$
 236 CLS
 238 IF B$="A" THEN GOTO 180
 250 PRINT AT 2,0;"WEATHER CONDITIONS"
 280 PRINT
 305 FOR B=1 TO A
 307 IF X(B)>=5 AND D(B)<=40 THEN LET Z(B)=4
 310 IF D(B)<=40 THEN IF X(B)<=4 THEN LET Z(B)=5
 315 IF X(B)>=5 AND D(B)>=50 THEN LET Z(B)=3
 320 IF D(B)>=50 AND D(B)<=80 THEN IF X(B)<=4 THEN LET Z(B)=2
 325 IF D(B)>=90 THEN IF X(B)<=4 THEN LET Z(B)=1
 330 PRINT B;" ";Z$(B);" ";K$(Z(B))
 335 NEXT B
 337 PRINT
 355 PRINT "DO YOU WISH TO ALTER "
 359 PRINT "ANY OF YOUR LOCATIONS"
 361 PRINT
 363 PRINT "TO RE-LOCATE MILLS TYPE ""Y"""
 365 PRINT "FUEL CONSUMPTION REPORT TYPE ""R"""
 370 GOTO 160
 400 PRINT AT 2,0;"REPORT ON FUEL AND COAL USED"
 403 PRINT AT 4,0;"COAL";TAB 12;"PETROL"
 404 PRINT
 405 FOR B=1 TO A
 407 LET ZA=INT ((RND*5)+1)*10
 410 IF Z(B)=1 THEN LET C=3
 415 IF Z(B)=2 THEN LET C=10
 420 IF Z(B)=3 THEN LET C=5
 425 IF Z(B)=4 THEN LET C=ZA
 427 IF Z(B)=5 THEN LET C=ZA
 440 LET TC=TC+C
 460 LET P=D(B)/10
 465 IF P<0 THEN LET P=A*P/-P
 467 LET P=P*4
 473 LET TP=TP+P
 475 PRINT "MILL ";B;"=";C;TAB 12;"LORRY ";B;"=";P
 477 NEXT B
 479 PRINT
 480 PRINT "TOTAL=";TC;TAB 12;"TOTAL=";TP
 481 PRINT
 483 PRINT "PRESS NEW LINE WHEN READY"
 485 INPUT S$
 489 LET H=A*150
 490 GOTO 650
 491 PRINT AT 2,0;"EARNINGS AND EXPENSES"
 492 PRINT
 493 PRINT "CORN HARVESTED=";H;"BAGS"
 495 PRINT
 499 PRINT "CHARGE PER BAG £";AE
 501 LET ZX=H*AE
 503 PRINT "EARNINGS=£";ZX
 505 PRINT
 507 LET TC=TC*5
 510 PRINT "COST OF COAL     £";TC
 515 PRINT "COST OF PETROL   £";TP
 520 LET MW=(TC+TP)/3
 523 LET MW=INT MW
 525 PRINT "MILLERS WAGES    £";MW
 527 LET XX=ZX/4
 530 PRINT "TAX ON EARNINGS £";XX
 535 PRINT
 537 LET TA=TC+TP+MW+XX
 540 PRINT "TOTAL EXPENSES £";TA
 543 LET W(YR)=ZX-TA
 545 PRINT "TOTAL NETT EARNINGS £";ZX-TA
 550 PRINT AT 17,0;"DO YOU WISH TO CONTINUE"
 560 INPUT V$
 565 CLS
 567 IF CODE V$=62 THEN GOTO 610
 569 IF CODE V$=51 THEN PRINT AT 19,0;" REPORT FOR .";YR;". YEARS "
 571 IF CODE V$=51 THEN SCROLL
 573 LET YRT=0
 575 FOR B=1 TO YR
 577 PRINT AT 20,0;"YEAR ";B;" NETT EARNINGS=";W(B)
 580 SCROLL
 585 LET YRT=YRT+W(B)
 587 NEXT B
 589 FOR N=1 TO 50
 591 NEXT N
 592 CLS
 593 PRINT AT 10,0;"CALCULATING TOTAL"
 594 FOR N=1 TO 50
 595 NEXT N
 596 CLS
 597 PRINT AT 10,0;"EARNINGS FOR ";YR;" YEARS=£";YRT
 600 STOP
 610 LET YR=YR+1
 615 GOTO 5
 650 PRINT AT 19,0;"ENTER PRICE YOU WISH TO"
 651 PRINT "CHARGE PER BAG OF CORN MILLED"
 655 INPUT AE
 670 CLS
 675 IF AE*H>=3001 THEN PRINT AT 10,0;"PRICE TO HIGH"
 680 IF AE*H>=3001 THEN GOTO 650
 685 IF AE*H<=3000 THEN GOTO 491
 900 STOP
1000 SAVE "WINDMILLS"
1100 GOTO 3
1900 STOP
2000 INPUT A$
2005 IF A$="" THEN GOTO 2000
2010 IF CODE A$(1)-29>=8 THEN GOTO 2000
2013 LET Z$(B)=A$
2015 IF CODE A$(2)-38<0 OR CODE A$(2)-38>=18 THEN GOTO 2000
2020 LET X(B)=CODE A$(1)-29
2030 LET Y(B)=CODE A$(2)-38
2040 LET D(B)=Y(B)*10-40
2060 RETURN
3000 DIM K$(5,25)
3005 LET K$(1)="WINDSWEPT AREA"
3010 LET K$(2)="OCCASIONAL WINDS"
3015 LET K$(3)="WINDY VALLEY"
3020 LET K$(4)="LIGHT WINDS AREA"
3023 LET K$(5)="SHELTERED AREA"
3025 RETURN
```

Rem memory

Andrew Norman,
St Albans,
Hertfordshire.

ZX-81

LARGE REM statements are useful for storing machine code and databases. This simple procedure can generate very large Rem statements on an expanded ZX-81 without a repeat key.

The program combines lines 1 and 2, which may be of any positive length, into a single Rem statement at line 1. This may be duplicated at line 2, using Edit, and the process repeated as often as necessary. Alternatively, store a Rem statement of convenient length at line 3 and duplicate at line 2 each time for more controlled growth of line 1.

I have produced a 12,000-character Rem statement with a 64K Super-Z board. Slightly larger statements should be possible by this method, with enough room in the first 16K for the program and display file.

```
1   REM (e.g., two full stops)
2   REM (e.g., four full stops)
10  LET TL1 = 256 * PEEK
    16512 + PEEK 16511
20  LET LL1 = 4 + TL1
30  LET PTL2 = 16508 + LL1 + 3
40  LET TL2 = 256 * PEEK (PTL2 + 1)
    + PEEK PTL2
50  LET NTL = TL1 + 4 + TL2
60  POKE 16512, INT (NTL/256)
70  POKE 16511, (NTL - 256 * PEEK 16512)
80  POKE (16508 + LL1), 128
90  PRINT (NTL - 2); "AVAILABLE BYTES IN
    LINE 1"
100 PAUSE 200
110 CLS
120 LIST
```

■

JAILBREAK

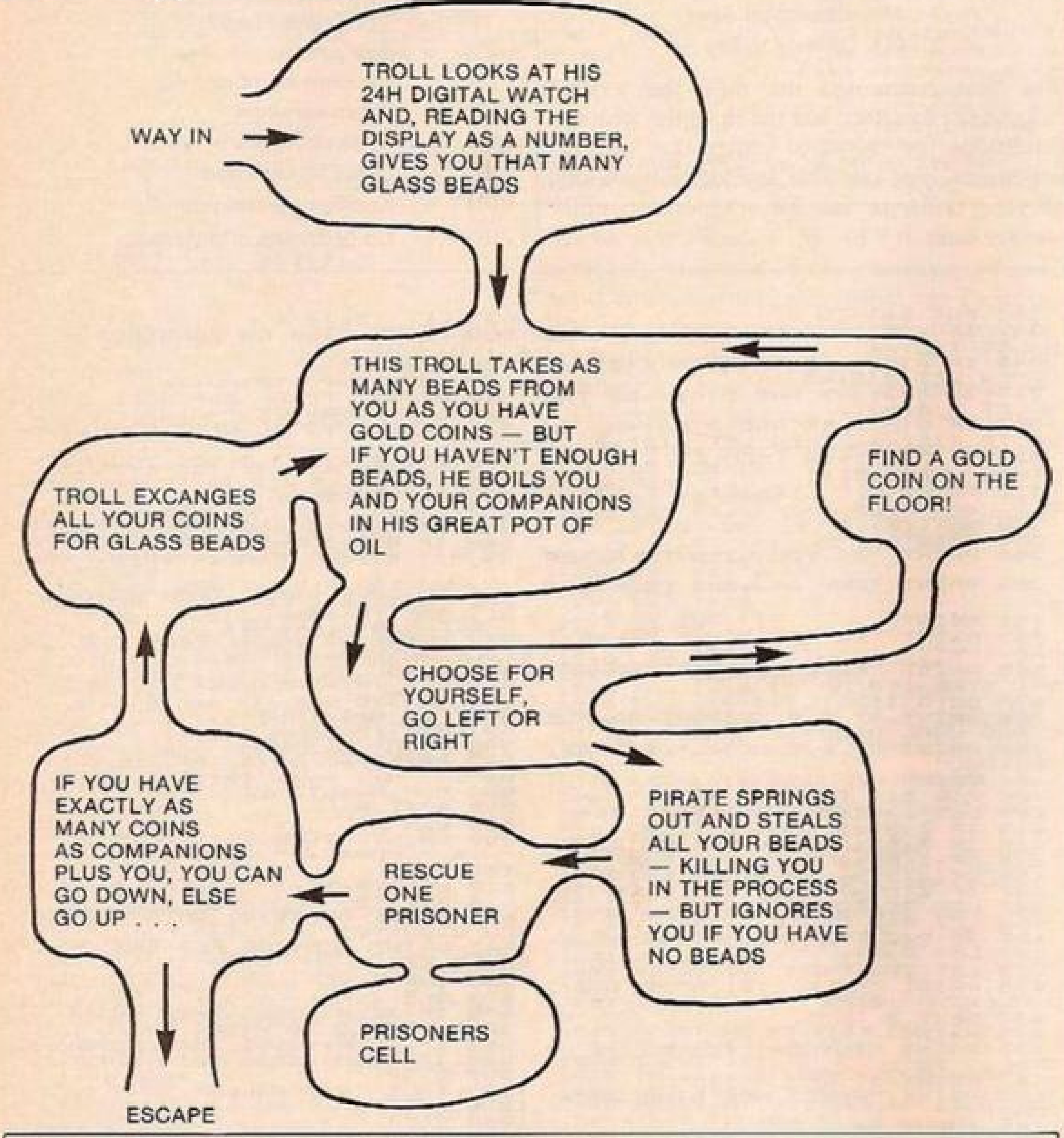
BY ANTHONY ROBERTS

As usual, the Wizard One-eye has put you to the test: you must enter the trolls' cave system and try to rescue the Wizard's friends in the prisoners' cell.

It is clearly important to enter the first cave at just the right time. What time must that be, and how many prisoners are there?

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in September. The name of the winner, the solution, and a competition report will be published in the November issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.



Program to solve the Bird Catcher problem.

```
10   LET Z = 1
20   LET Z = Z + 2
25   LET N = Z
30   LET X = 1
40   LET X = X + 2
50   LET Y = X
60   LET A = 0
70   IF Y = 0 THEN 110
80   LET A = A + X
90   LET Y = Y - 1
100  GOTO 70
110  IF A > N THEN 190
120  LET Y = A
130  IF Y < X THEN 40
140  IF Y = X THEN 170
150  LET Y = Y - X
160  GOTO 130
170  IF B = 0 THEN 1000
180  PRINT "DONE IT"; Z
185  STOP
190  IF B = 1 THEN 1000
200  LET B = 1
210  LET Y = 2
220  LET N = N - 1
230  IF N = 0 THEN 260
240  LET Y = 2Y
250  GOTO 220
260  LET N = Y - 1
270  GOTO 30
1000 PRINT "FAILED"; Z
1010 LET B = 0
1020 GOTO 20
```

Z = INITIAL NUMBER OF CAGES; N = NUMBER OF CAGES DURING TRIP X = BLACKBIRDS; Y = BLUEBIRDS; A = SONGBIRDS; B = PARROTS

Competition results

July's competition drew almost 1,000 entries. Rainbow, Aurora, Eclipse, Harlequin, Senator, Parrot, Tardis, Lakertron, Arthur Ascii, Sinclair Power Pixie were some of the names suggested for the Spectrum. We awarded the prize of a ZX Spectrum to R Burgess, 51 Constance Crescent, Hayes, Kent for his "Spectre — there is only a ghost of a chance of seeing one". This was not the only entry suggesting "Spectre", just the lucky one.

Other entries were more rapturous, like the "Miracle" and the "Dazzler", but I Hunt's "the Messiah because it's a Godsend" seemed to be carrying admiration too far. Some people thought the Spectrum should have been called . . . the Spectrum. As R Fletcher added "now there's a coincidence".

More original was A Swale with "the Botham, the great all-rounder that hits the opposition for six", while G Robbins thought the Spectrum should have been called "to my attention earlier". The last word must go to G Wright for his "Rom Greenwood — this time we will get it right".

A number of people pointed out an inconsistency in the rules for July's Bird Catcher problem. The box beginning "If you have a parrot . . ." tells you to release all but two of your blackbirds, but by this stage you will have already released all your blackbirds. This understandably deterred most people from proceeding further.

If you ignore the inconsistency and assume that you can exit from the box with two blackbirds, a solution is possible. The following program translates each instruction into a Basic statement and gives an answer of 13 cages. Line 210 translates the amended instruction. The closest solution came from J Clark, 32 Bencombe Road, Purley, Surrey, CR2 4DG, who has been awarded the £15 book token. ■

Solution to the July crossword.



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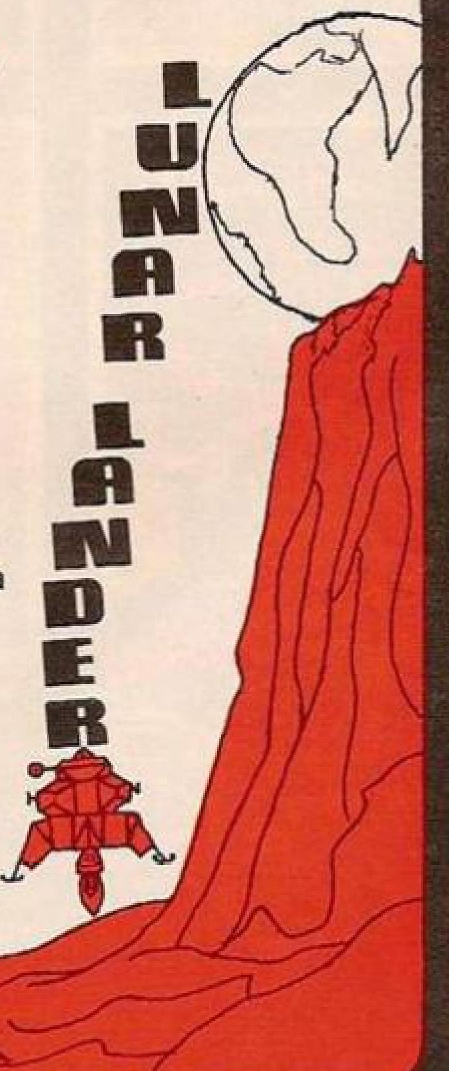
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As we said, this isn't a toy.

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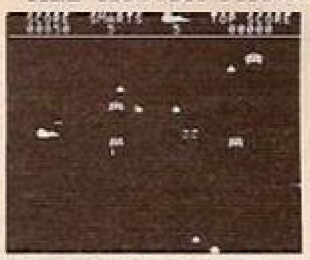
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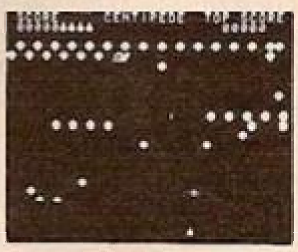
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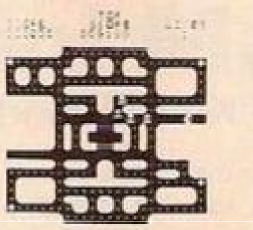
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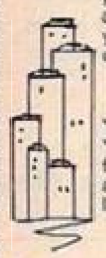
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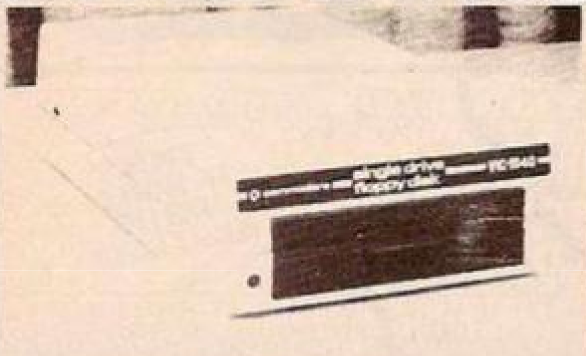
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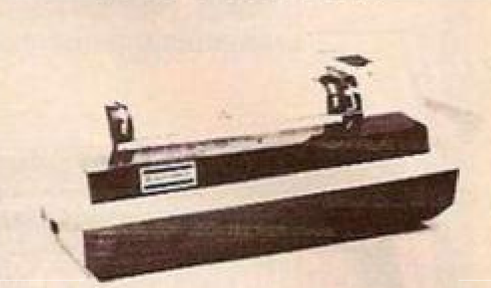
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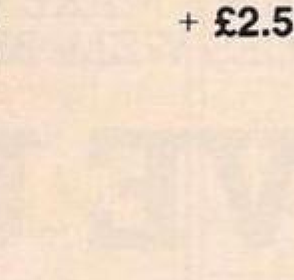
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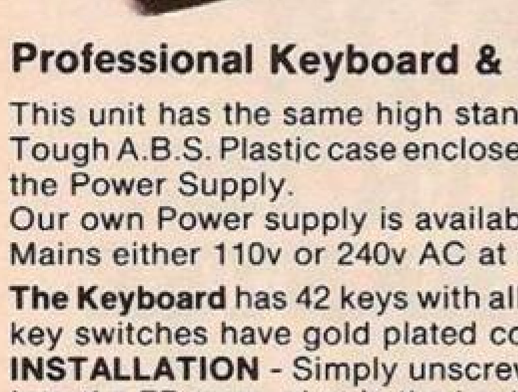
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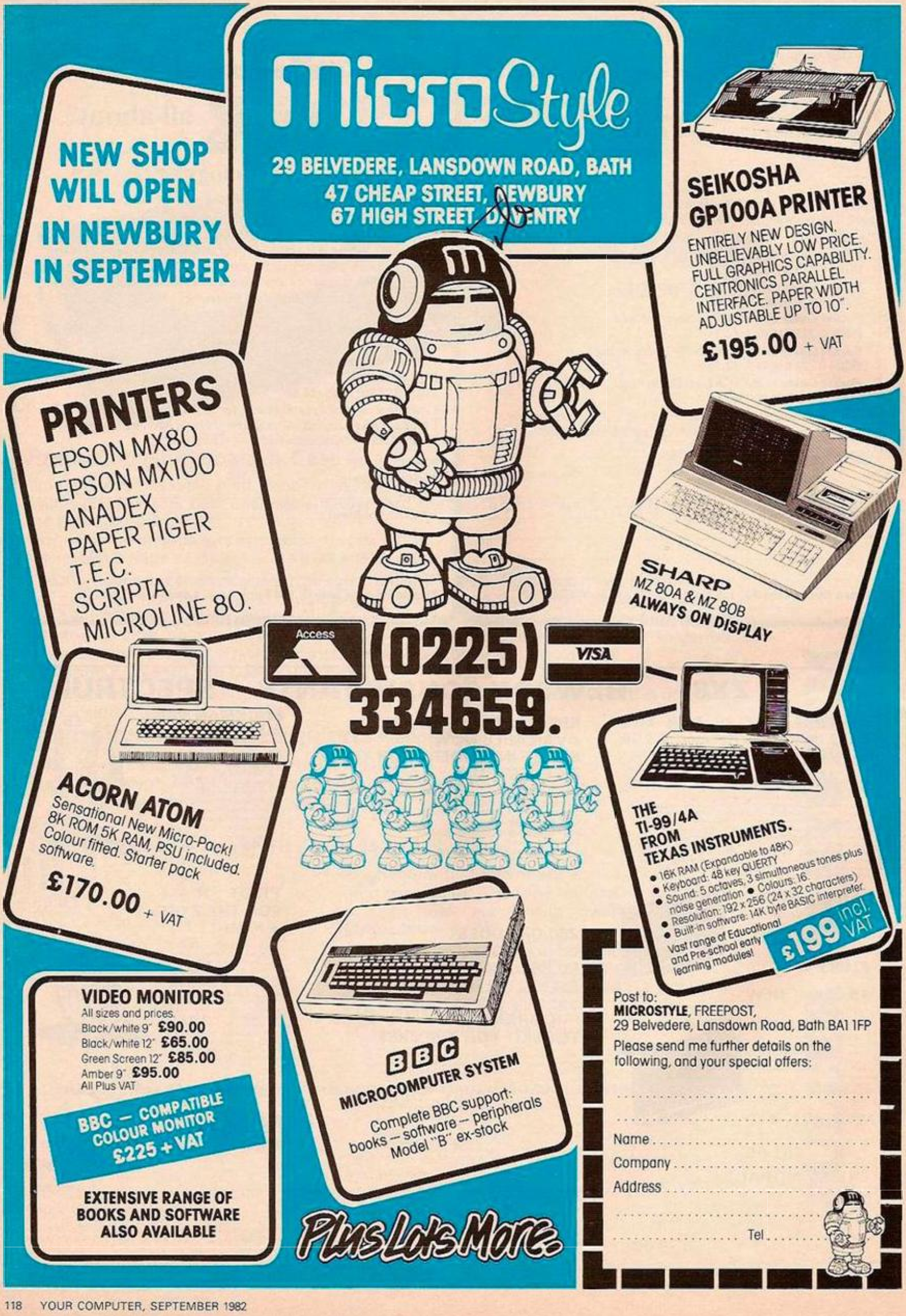
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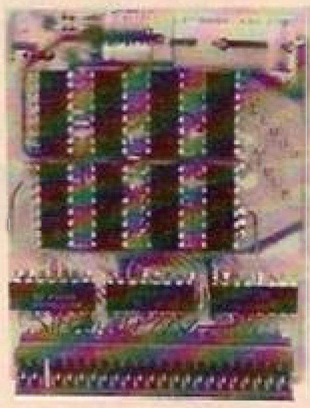
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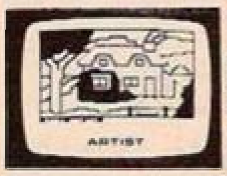
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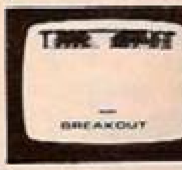




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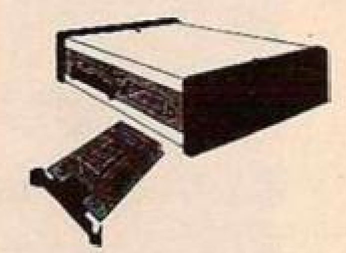
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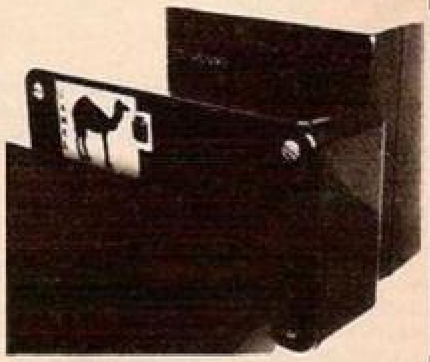
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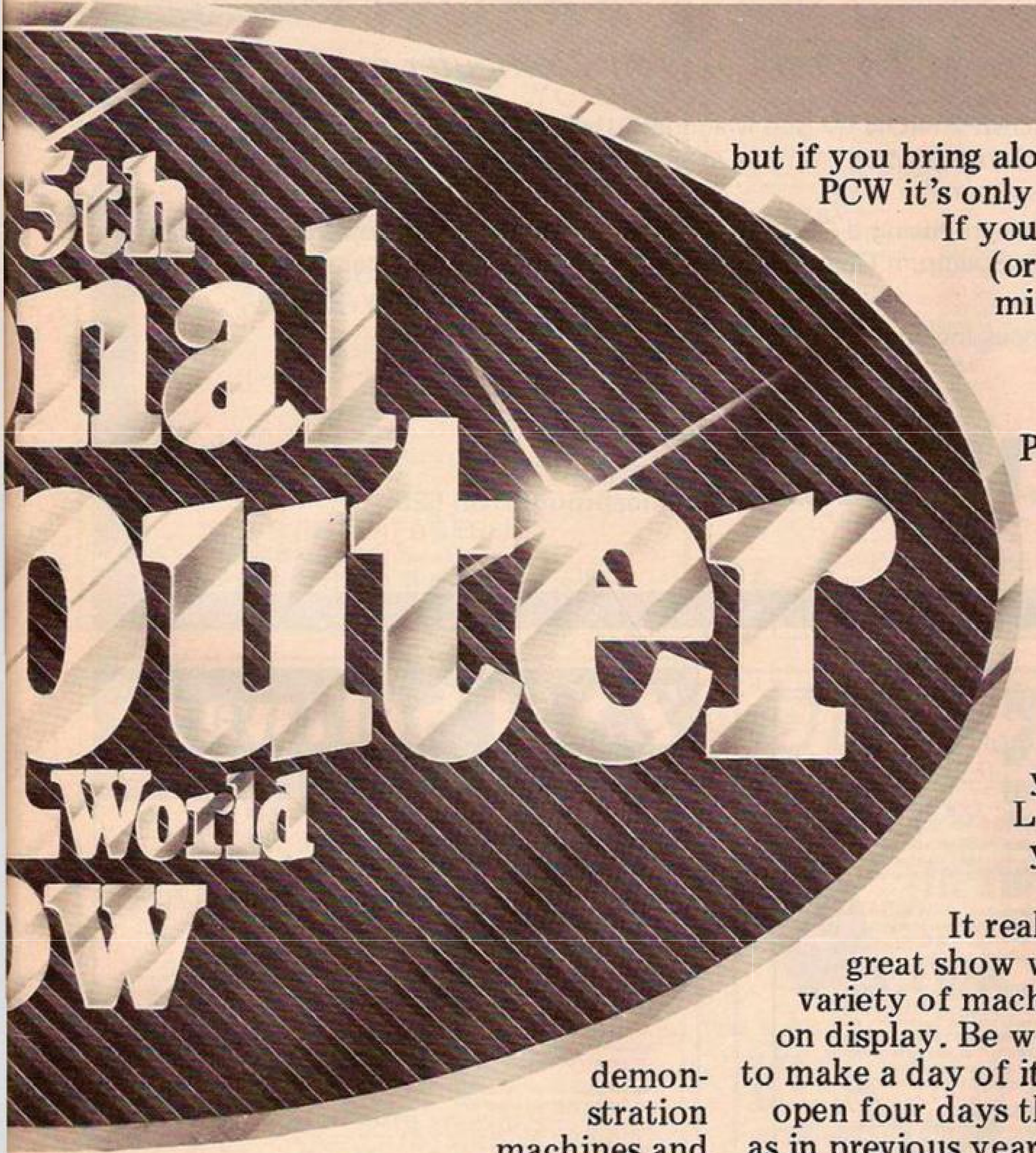
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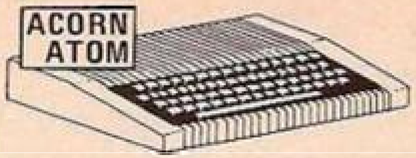
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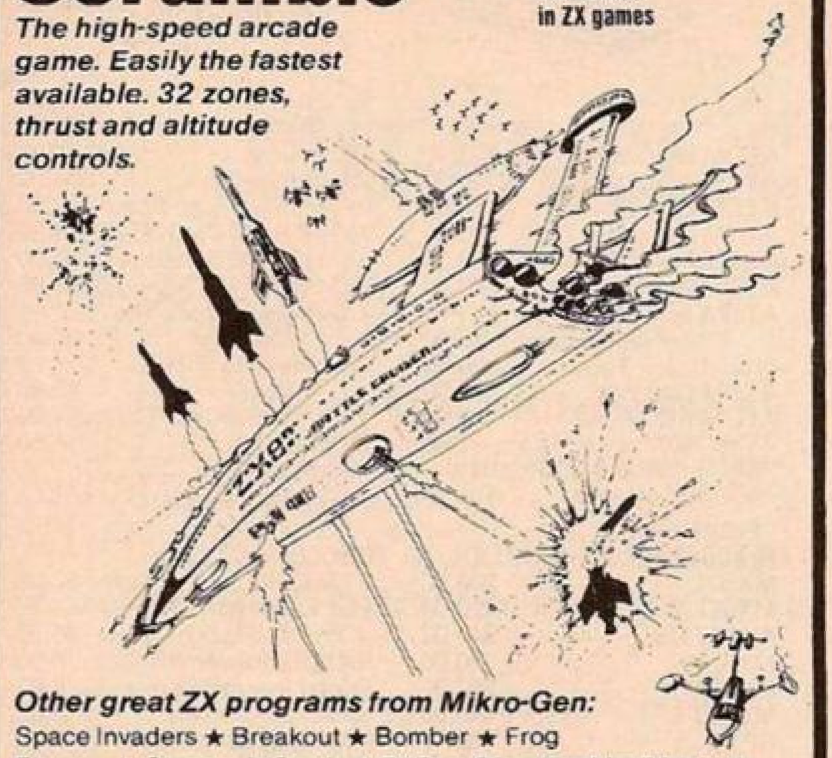
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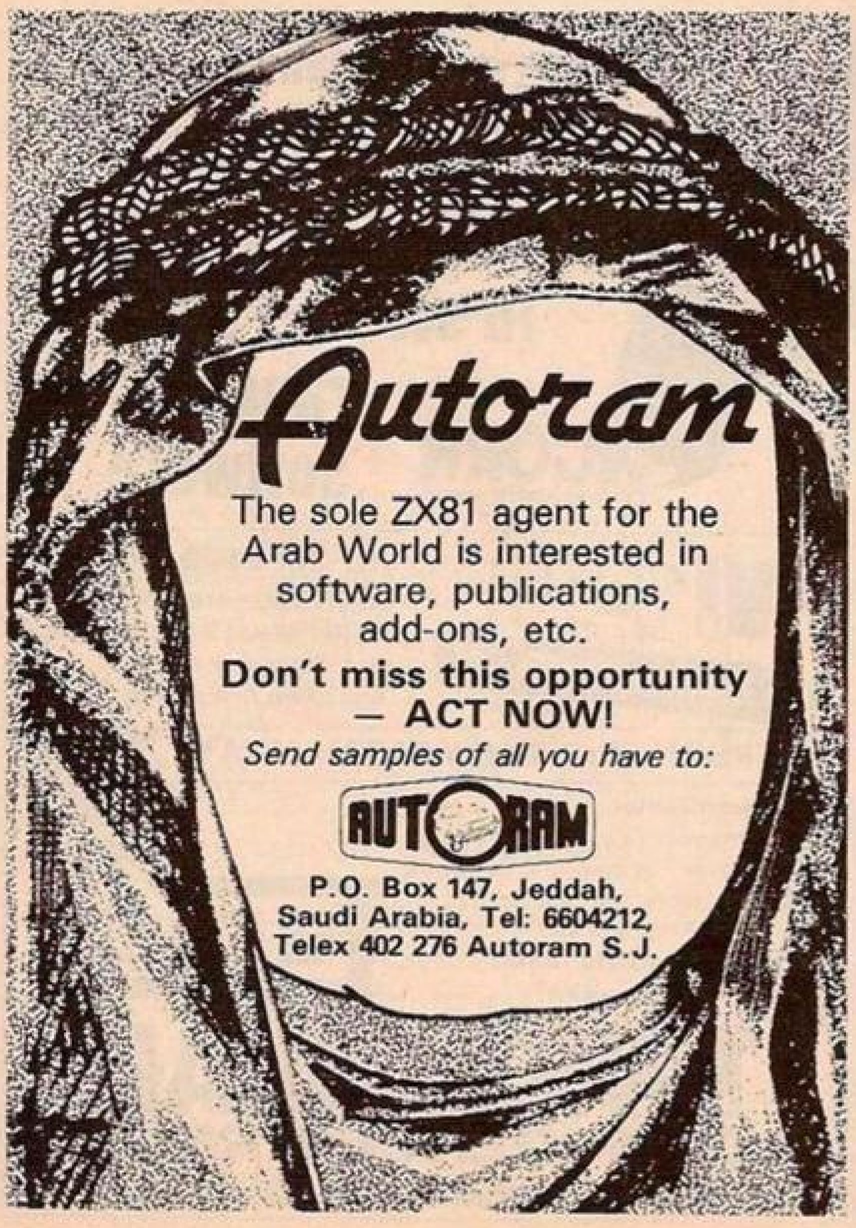
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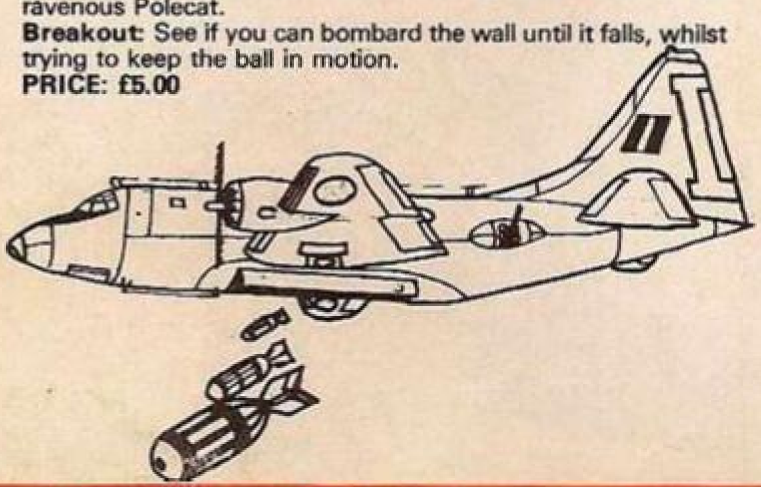
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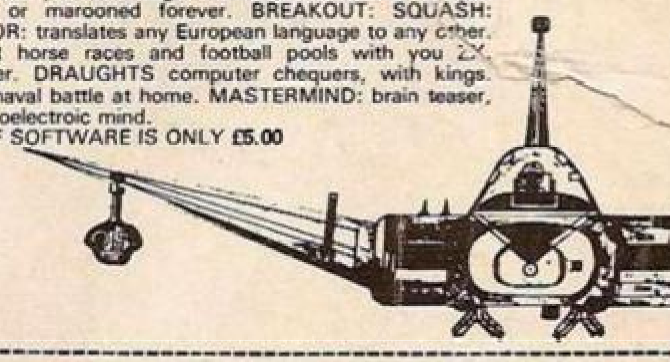
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